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CHALLENGES AND ISSUES FOR U.S. PORTS: IMPACT OF THE NEXT GENERATION CONTAINERSHIPS AND CARRIER ALLIANCES ON COMMERCIAL PORTS AND MILITARY OPERATIONS

by

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December 1997

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The emergence of the next generation containerships (mega ships) and global shipping line alliances will bring about fundamental changes in the operational framework and infrastructure of many U.S. ports. By all indications the end result will be more a streamlined and competitive container industry where ocean carriers will operate with load center and feeder port configurations. For many ports, this new environment will dictate addressing the problems of inefficiencies in productivity, landside access congestion, and dredging in order to remain competitive. From the military perspective, the changing environment and problems facing the ports may limit accessibility and availability at the nation's strategic seaports.

This thesis examines the issues of the changing port environment and impact on military throughput. It also explores the automation and technological concepts available or being developed which can improve military efficiency.

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CHALLENGES AND ISSUES FOR U.S. PORTS: IMPACT OF THE NEXT GENERATION CONTAINERSHIPS AND CARRIER ALLIANCES ON COMMERCIAL PORTS AND MILITARY OPERATIONS

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The emergence of the next generation containerships (mega ships) and global shipping line alliances will bring about fundamental changes in the operational framework and infrastructure of many U.S. ports. By all indications the end result will be more a streamlined and competitive container industry where ocean carriers will operate with load center and feeder port configurations. For many ports, this new environment will dictate addressing the problems of inefficiencies in productivity, landside access congestion, and dredging in order to remain competitive. From the military perspective, the changing environment and problems facing the ports may limit accessibility and availability at the nation's strategic seaports.

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I. INTRODUCTION

The emergence of next-generation container ships (mega ships) and global shipping alliances has the potential to bring about fundamental changes in the traditional operational framework and infrastructure of U.S. ports in upcoming years. By all accounts, the result--more streamlined and competitive carrier alliances calling on fewer ports - will maximize efficiency and reduce costs. Carriers, driven by the prospect of increased revenues from growing international trade markets, will pressure ports to either improve facilities and productivity or run the risk of losing business. For an industry currently experiencing financial strains from competition, whether or not to invest additional dollars into infrastructure improvements with no guaranteed return on investment is a tough decision to make.

From the military perspective, the restructuring of U.S. ports can potentially limit port accessibility, aggravate loading and unloading delays, and raise dependence on containerized shipping operations. This thesis will examine the changes in U.S. port operating practices, shortcomings in infrastructure support, and the implications for military unit deployments.

This chapter provides a brief history of the issues and establishes the significance of studying the issues from the viewpoints of both civilian port managers and government transportation officials who plan port activities. Also, this chapter discusses the scope, methodology, and application of the research conducted in this thesis.

A. BACKGROUND

Today, the nation's ports are going through an unprecedented restructuring period due to the increasing demands of carrier alliances and the introduction of larger container ships. During this transition period, hundreds of jobs and billions of dollars in cargo will shift from one local economy to another. [Ref. 29] In some cases, ports will lose significant portions of their clientele to more attractive ports with greater capital

resources and more appealing geographical locations. Ultimately, restructuring will probably lead to many ports being relegated to secondary roles as regional feeder ports, supporting larger ports referred to as "load alliance centers" or "principal ports."

Over the past forty years, U.S. ports have invested more than ten billion local, state and federal dollars [Ref. 3:p.46] in developing facilities and purchasing equipment. These actions were necessary to keep pace with emerging technological trends and carrier requests within the shipping industry. Unfortunately, many sites will continue to be pressured into investing millions as shipping lines transition into new 6,000 TEU container ships. These gigantic ships operated by strong shipping alliances will undoubtedly eliminate unnecessary port calls, generate enormous port competition, and further strain some of the operational weaknesses (e.g., bottlenecks and low productivity) of many U.S. ports.

Furthermore, the material-handling facilities and terminal infrastructures at many ports are presently inadequate to meet the unusually high peak demands of discharging and on-loading these ships. Ports will have to balance the value of implementing more efficient operations within their existing structure with the potential cost of expensive expansion projects. Given the capital expense of renovation, port authorities and local governments are facing some tough managerial decisions. Should they invest in major port expansion projects in an industry already experiencing excess capacity, knowing that that their investment might not yield increased profits? Or would the more prudent choice be to solicit smaller carriers and develop niche markets?

The military is concerned that the current restructuring might eliminate strategically located ports, and they wonder if those that do remain will be accessible during contingencies. Some ports, instead of closing down, will transition into regional feeder ports or load alliance centers; however, there is still the question of whether they will continue to provide the level of productivity that both the military and commercial customers have come to expect. Military planners and other government agencies are

studying these issues quite intensely because they have the potential to affect mobilization efforts at many ports throughout the country.

The primary issue for the military is whether the realignment of certain ports will impede the accessibility and throughput at these selected sites. Considering the current issues surrounding port congestion and shortfalls in landside access improvement initiatives, unless these issues receive the necessary attention, they will only grow in magnitude in the coming years.

B. SIGNIFICANCE OF RESEARCH

A thorough study of the changes in existing U.S. port structure is important because port facilities play a vital dual role in our national strategy objectives by providing: (1) the medium to facilitate international trade and (2) direct mobility support of our armed forces. Any changes to the existing framework, no matter how subtle, will influence these two areas significantly. Therefore, it is important that the strategic planners associated with the ports and with military mobility fully understand the implications of larger container ships and the emergence of carrier alliances into U.S. ports. The information in this thesis is intended to help increase this crucial understanding.

This thesis will also document and analyze the extent to which military emergency mobilizations disrupt domestic container ports' throughput and productivity. Although several agencies have initiated limited studies in this area, there is still an overwhelming level of uncertainty about these issues. This debate has led to a division in opinion among professionals in the port industry. Given the importance of the viability of this nation's ports, a study regarding to these issues and perspectives is justified.

The primary research questions this thesis addresses are as follows:

1. What are the dominant influences and issues initiating the restructuring of the container shipping industry?
2. How will containership size, the fleet as a whole, and carrier alliances most

likely evolve over the next five years?

3. Taking into account the challenges of larger containerships and carrier alliances, what actions must port authorities take to retain their competitive advantage over ports operating within the same geographical market?
4. Given the shifting trends of regional feeder ports and load centers, as well as larger ships, what effects will this restructuring have on military unit deployment planning and operations?

C. RESEARCH SCOPE AND METHODOLOGY

This study is intended to provide an impartial analysis of the effects next-generation container ships and carrier alliances will have on existing port infrastructure and operations. The thesis places particular emphasis on the potential problems of port accessibility and congestion for military units during contingency deployments. Specifically, the study clarifies the various opinions and initiatives being implemented by both the military and commercial sectors to adjust to the changing port environment.

This thesis does not provide a comprehensive quantitative analysis of the situation, but will contribute to the professional body of knowledge by presenting a clearer understanding of the relationships and issues involved. Additionally, the thesis will provide a general overview of the existing U.S. port support structure and examine the roles and responsibilities port administrators have in addressing prevalent industry-wide concerns.

Research information was obtained through the following sources:

1. Published documents and reports from various military and civilian transportation agencies, including the American Association of Port Authorities (AAPA), Military Traffic Management Command (MTMC), Military Sealift Command (MSC), and the Maritime Administration (MARAD) of the Department of Transportation (DOT).
2. On-site visits to the Port of Oakland and the 1032d Major Port Command.

2. On-site visits to the Port of Oakland and the 1032d Major Port Command.
3. Interviews with knowledgeable personnel in the port and shipping industry.
4. Participation in the North California Port Readiness Committee Port Readiness Exercise (PRX) 97 hosted by the Military Traffic Management Command (MTMC) Western Area and the Marine Safety Office San Francisco Bay.

Additional information was obtained through a review of current professional journals, periodicals, and news briefs from various industry public affairs offices. A comprehensive compilation of this data provided the information needed to answer the research questions.

D. RESEARCH APPLICATION

The civilian port authorities and military and governmental transportation planners are the intended beneficiaries of this thesis. Planners may apply the findings and recommendations of the thesis in order to better understand the interrelationships and requirements between military and civilian port operations. Specifically, the study is beneficial because it:

1. presents to those directly responsible for port planning and policy initiatives the positive and negative impacts of next-generation container ships and carrier alliances on commercial and military activities.
2. examines how restructuring of certain commercial ports identified as strategic ports of embarkation may affect military accessibility and throughput at these facilities.
3. and discusses what actions must be undertaken by port authorities and their supporting sectors in the "intermodal pipeline" to maintain the economic viability of militarily important commercial ports.

E. ORGANIZATION OF THESIS

The first chapter of this thesis provides an introduction and general overview of issues pertaining to the U.S. port industry. It also addresses the research and methodology used to analyze the principal research questions of this thesis.

Chapter II focuses on the present structure of U.S. ports, explaining the role and responsibilities of port authorities. The economic impact of ports on national, state, and local economies is evaluated.

Chapter III discusses the three major developments currently impacting changes in U.S. port infrastructure: competition in ocean transportation, introduction of the next-generation containerships and the emergence of carrier alliances.

Chapter IV elaborates on the implications for U.S. ports as a result of these developments. This chapter also provides an in-depth probe into the areas of operation that are likely impacted by larger container vessels and alliances. Chapter IV concludes by identifying current initiatives underway by public- and private-sector agencies to mitigate or counter the negative aspect of these influences.

Chapter V examines the implications for military throughput and accessibility given the external pressures being placed on U.S. public ports. Specifically, laws that give military priority in the usage commercial berths and staging areas are reviewed. The chapter also compares and contrasts the port environment before and after Desert Shield/Desert Storm to determine whether or not the productivity and accessibility of ports have diminished for military usage.

Finally, Chapter VI contains the summary, conclusion, and recommendations for further research.

II. PRESENT STRUCTURE OF U.S. PORTS

Activities at U.S. ports involve the coordination and integration of a multitude of public and private-sector interests. "The modern port in the United States can be described as a community of independent enterprises tied together by a common interest in the affairs of maritime management." [Ref. 23:p.29] Central to this community is an entity known as the port authority or agency, which has served increasingly over the past few decades as landowner, operator, developer and public relations agent for the port. [Ref. 23:p.29] Its scope of responsibilities resembles that of any public enterprise with a goal of achieving profit and economic self-sufficiency. Despite growing public scrutiny and environmental awareness, as well as ever-increasing industry-wide competition, most ports have maintained a vigilant focus on their bottom line by: (1) offering state-of-the-art terminals and facilities to carriers, (2) adapting to other industry changes and innovations, (3) identifying alternative sources for financing costly expansion projects, and (4) remaining competitive against regional ports.

Recently, however, new challenges and pressures to improve customer service have forced many ports into expensive technological upgrades and expansion of facilities. These projects are moving forward despite shortfalls in revenue and dwindling subsidies brought on by increased competition. In most cases, the catalyst for change within the public port industry has been the continued growth in vessel size and the rationing of port calls by influential ocean carrier alliances. Even though the intermodal industry as a whole is enjoying new-found economic success in the area of transportation, the port industry, a key in the network, is struggling to find its identity and purpose. Complicating matters is the industry's excess capacity, which jeopardizes the existence of some ports and also serves as a basis for criticism of costly new projects.

Ircha [Ref. 26:p.28] refers to the current time as a period of economic turbulence impacting the port industry. This turbulence is characterized by the existence of: more

complicated markets and competitive situations (exemplified by growth of container load centers and inland intermodal systems); changing technology; shifting customer preferences (shipping lines moving to competing ports); extensive capital requirements (mechanization for productivity gains); and reduced time for decision making. Rapid advances in telecommunications technology tying together computerized logistics systems, such as in the development of electronic data interchange (EDI), add to the turbulence of the ports' economic environment. [Ref. 26:p.28]

Adding to the volatility of these issues is the growing public awareness of the environmental and economic actions of local port authorities. Ports need deeper channels and more acreage to remain competitive. Dredging and the disposal of sediments disrupt the chemical balance and marine life of channel floors, much of which has been contaminated through many years of industrial pollution. Furthermore, because of intensified competition, many ports are more conscious of issues that might impact or disrupt their commercial activity. Customer (carrier and shipper) satisfaction is the number one priority, given the fear of potential losses. With the military competing against commercial customers for the same berths and terminal spaces, port authorities are more skeptical about giving over free reign of the port during military deployments. Balancing military requirements with the sensitivity of highly profitable commercial customers is a growing concern in the industry and within the Department of Transportation (DOT) and Department of Defense (DoD).

This chapter will provide an overview of the present structure of U.S. public ports, including a discussion of the operational framework, the physical distribution of ports, the economic impact, and various issues currently facing the port industry.

A. FRAMEWORK OF OPERATION

1. Port Development in the U.S.

In earlier days, port caretaking was a collective effort of local business interests, such as farmers, manufacturers, and retailers, working with commercial carriers and

shippers, such as steamship lines and railroad companies. [Ref. 44:p11] During these formative years, the railroad was the dominant influence in the port industry, amassing economic and territorial power. Initially, ports prospered only when railroads served their respective waterfronts by providing dedicated access to the hinterland. [Ref. 42:p.283] As the only true mode of transportation to move goods throughout the country, the railroads were able to monopolize the market by developing networks between ports and choosing which ports were most advantageous to serve.

Local businessmen viewed the operating practices of the railroads as monopolistic, and a growing atmosphere of resentment began to emerge. Gradually, the loss of control by local businesses led to civic dissatisfaction: concerns about the railroads' monopolistic position; the need to promote new trade; the divided interests of the railroad serving competing ports; and the lack of orderly port development due to fiercely competing interests within some ports (between competing railroads and their piers). [Ref. 26:p. 283] By the start of the twentieth century, a trend toward public ownership and operation of port land and facilities began.

Involvement in port affairs did not evolve entirely out of resentment toward the railroads. Instead, many people, both then and today, view the port and surrounding infrastructure as public property - lands that should be managed by public officials in the best interest of the taxpayers who helped finance the construction of the facilities. This concept maintains that the port serves as the "public highway," assuring free and equitable access to all legitimate users of the waterfront. [Ref. 26:p.284] In short, the establishment of port authorities conveys the perception that the public should have an audible voice in the management of its municipality's port affairs.

Today, well over 150 ports operate in the U.S.; approximately 65 to 75 percent (reference dependent) are commonly referred to as public ports operated by self-governing port authorities in various communities. The emergence of port authorities has increased considerably from the turn of the century, when there were only four port authorities in the U.S. - San Francisco (established in 1863), New York (1871),

Philadelphia (1885), and New Orleans (1896). [Ref. 26:p.283] Although operational control has shifted away from local merchants and shippers, the industry is still held accountable for acting in the public's best interest.

2. Ports as Public Enterprise

Describing the supervisory structure of the typical U.S. public port management organization is a unique challenge, considering the varying degrees of complexity from coast to coast and within certain states. By all definitions, public ports are public enterprises, a particular form of government that has flourished in this country since the late 1940s. [Ref. 23:p.13] Fair suggests the term port authority is used to apply to "any quasi-autonomous or quasi-independent agency which has the adequate authority and freedom of action to provide a strong and independent effective management of a port." [Ref. 17:p.43] In real-world application, port authorities can be best categorized as a mixture of both private and government enterprise - a hybrid reflecting certain characteristics of each.

Port authorities are viewed as "public domain" because local governments claim the rights of ownership, statutes establish them and dictate objectives, and, often, public subsidies supplement day-to-day operating budgets. Since the majority of supervisory officials serving at U.S. ports (such as boards of directors) are elected officials or political appointees, they are committed to serving their respective constituents with respect to achieving certain economic goals. Balancing the business and public aspects of the position is difficult because of conflicting demands, concerns and interests. Port authorities are very much like commercial business enterprises with similar missions and objectives; indeed, their highest priorities are to effectively manage existing resources and to ensure economic self-sufficiency. However, port authorities do not answer to stockholders, but, instead, to parent governments.

Status as a public enterprise does carry certain advantages - most especially, the ability to act independently outside of the normal government bureaucracy channels with a degree of flexibility not afforded to other governmental agencies. The freedom to make independent management decisions is a private-sector trait exploited by public port authorities to their advantage. As a public enterprise, a port authority also has the ability to branch out into other revenue-making functions. Table 1 is a listing of non-marine cargo related activities some ports participate in. Another advantage or source of power is the ability to raise funds and build facilities. [Ref. 26:p.14] Other powers assigned to ports typically fall into three categories: real estate, land use/environmental, and fiscal. [Ref. 26:p.14]

Table 1
Non-Marine Cargo Activities in 18 Ports

Noncargo Activity	Number of Ports
Airport	05
Fishport	08
Marina	08
Cruise ship services	09
Waterfront development	07
Parks and viewpoints	10
Mitigation	10
Marine resource development	06
Nonmarine resource development	02
Civic functions	05
Foreign trade zones	13
Sister city (foreign relations)	03
Land cargo transportation (trucking, rail)	06
Computer services	09
Economic development	11

[Ref.23]

With respect to real estate, ports are given the right to acquire, lease, and mortgage land as they deem necessary. Ports also possess the power of eminent domain to use land in the best interest of the public. Subsequently, port authorities are able to own or influence an enormous amount of the waterfront, and this is a considerable source of inherent power. [Ref. 26:p.13] Land use/environmental powers by some standards have been dramatically curtailed in recent years because of growing public environmental awareness and commercial developers' interest in prime waterfront real estate property.

The public's concerns about the environment, noise and traffic congestion in particular, have caused considerable delays in expansion projects in Oakland, Los Angeles/Long Beach, and Charleston. As recently as two decades ago, the public had no involvement in these sorts of issues. And, with regard to fiscal powers, ports are capable of generating their own revenues and investing in opportunities to increase profits. These fiscal powers will be elaborated on in subsequent chapters.

On the one hand, these inherent powers enable port authorities to function with greater freedom and to act more effectively in the increasingly competitive environment of the port industry. On the other hand, our Constitution calls for a system of checks and balances to ensure that public interest is foremost and that individuals can not exert too great an influence in promoting their own desires in a public enterprise. Thus, the ports are burdened with constraints that separate them distinctly from private businesses. For example, "Sunshine Laws" require open public hearings on expansion projects or improvements to landside accesses to improve throughput. Any business conducted by the port, with few exceptions, must be open for discussion and debate by all interested parties.

3. U.S. Port Management Structure

Considering the wide spectrum of issues ports must manage, the industry is surprisingly uniform in its management configuration and organizational structure. There are some isolated, unimportant exceptions to the public enterprise model, such as New

Haven, Connecticut and other private ports serving bulk commodity terminals. [Ref.6:p.285] However, across the industry, there are typically two distinct groups of managers in today's port. The first group are personnel within the numerous departments or divisions of the port authority who implement policy, perform administrative functions, and supervise daily operations. Engineering, marketing, public affairs, and strategic planning are common departments set up to support and promote the port's activities.

Supervisory-level personnel are the second group of individuals serving on port authorities as commissioners or board members. Most ports add an additional step by appointing an executive director to oversee port management functions. Traditionally, the main responsibility of port authority members (board members or commissioners) had been oversight and strategic planning for future developments of the port. Their position in the hybrid mixture of public and private enterprise often generates conflicting goals and objectives because they attempt to satisfy a number of competing interests. [Ref. 26:p.24] Despite the outside distractions, the primary focus of port officials is the maximization of waterborne commerce for their individual port. [Ref. 26:p.24]

Accountability for their actions is the responsibility of the parent government's established administrative framework. Table 2 depicts ten typical jurisdictional levels in the U.S. port system, ranging from the most decentralized to the most centralized form of administrative authority. The table shows that administrative authorities within the state of California are more "liberal" compared to their other west coast counterparts. The diversities in the alternative port jurisdictional arrangements by no means indicate that port authorities prefer one arrangement over another.

Given the range of alternative jurisdictional systems in the U.S., it is not surprising that the method by which members are appointed or elected to serve on the boards of port authorities varies widely. The selection process is but one of many differences among ports. Other variations can found in employee hiring practices,

opened versus closed meetings requirements, audit reports, financial report relations and restrictions, borrowing authority limits, and taxing authorities. [Ref. 26:p.288]

Table 2

Alternative Port Jurisdiction Arrangements

Forms	Most Decentralized	Examples
Private		New Haven, CT; Alameda County, CA
Local city department		Los Angeles, CA; Long Beach, CA; Oakland, CA; San Francisco, CA; Milwaukee, WI; Chicago (Navy Pier) Alaskan City Ports
Extension of city council		Richmond, CA; Seward, AK
Local special districts		Seattle, WA; Tacoma, WA; Chicago (Regional Port District), IL; Coos Bay, OR; Humboldt Bay, CA; Oxnard, CA
County Agency		Cleveland, OH
Multi-county agency		Portland, OR
Unified area wide special District		San Diego, CA
State agencies		Maryland, Hawaii, Maine, N. Carolina
State authorities		Massport; Burns Harbor, IN
Bi-state authorities		New York/New Jersey; Delaware River Port Authority, PA/NJ; St. Louis, MO/KS
National boards		Absent in the United States
	Most Centralized	

[Ref.23]

4. Port Development Finances and Revenues

Financing capital development projects and generating self-sustaining revenue streams remain two of the prominent financial concerns for public ports. With container tonnage expected to double by the year 2010, ports need to quickly expand existing infrastructures and terminal facilities to accommodate projected growth. [Ref. 46:p.41] The continued upswing in growth, which is expected to continue into the 21st century, signals the need for ports to invest in costly expansion projects and equipment procurement. Therefore, feasible alternative funding sources for these projects must be identified. In an industry that has invested more than $15.5 billion in capital improvements to its facilities between 1946 and 1995 [Ref. 47:p.3], many are questioning if these practices can continue.

Ports and terminals now spend, on average, $1billion annually on capital expenditures, but such expenditures may no longer be prudent, given increased competition and the scarcity of public funds. Table 3 summarizes the proposed expenditures for U.S. ports through the year 2000. As Table 3 indicates, future capital expenditures will increase to approximately $1.2 billion annually (over a five-year period), a $200 million increase over the current national average of $1 billion.

Not only is expansion costly, but daily operating costs also are expensive because budgets must cover equipment maintenance and procurement, dredging and disposal of sediment, as well as other general and administrative costs. Ports typically receive their operating capital from operating revenues, financing, or some means of appropriations. Additionally, all U.S. ports receive some sort of subsidies to support operations from the federal, state or parent government. Table 4 summarizes the various short-term and long-term sources available to ports to secure the capital for day-to-day operations and port projects.

Over the past decade, the allocation of public funds, in particular subsidies supplementing operating budgets of government agencies, has been evaporating. Taking

into account budgetary shortfalls and the growing demand for public funds, ports will continue to face stiff competition for scarce public funds. Parent governments are, therefore, calling on port authorities to become more self-sufficient and financially independent to offset the loss of subsidies. Achieving self-sufficiency is difficult considering the many expenses that must be covered to operate a port effectively. Ports are self-sufficient only if they generate enough operating income, interest income, and other earnings to pay their operators, maintenance, security, sales, administrative, and depreciation expenses without reliance on tax receipts or outside contributions. [Ref. 48:p.xvii]

Table 3
U.S. Port Capital Expenditures for 1996 - 2000
(Thousands of Dollars)

Region	Expenditures	Percent
North Atlantic	$254,113	4.2%
South Atlantic	1,281,626	21.2%
Gulf	967,099	16.0%
South Pacific	2,668,139	44.3%
North Pacific	792,248,	13.1%
Great Lakes	72,826	1.2%
AK, HI, PR, & VI	-	-
Guam, Saipan	-	-
Total	$6,036,051	100.0%

[Ref. 47]

Table 4
Methods of Financing Summary

Method	Long Term Source	Short Term Source
Traditional	General Obligation Bonds Revenue Bonds (i.e., IDBs, Consolidated) Governmental Assistance (i.e., Federal, State, Local) Port Earnings	Port Earnings Governmental Assistance Bank Loans
Innovative	Leasing Arrangements Zero Coupon Bonds Variable Rate Bonds	Tax-Exempt Commercial Paper Warrants Bond or Tax Anticipation Notes Variable Rates Demand Securities Option Tender or 'Put' Bonds Letter/Line of Credit
Combination	This category includes various combinations of long-and short-term sources, subject to the specific port's needs and access to financing options.	

Source: (1) AAPA Port Expenditure Survey
(2) John E. Petersen and Wesley C. Hough, Creative Capital Financing: For State and Local Governments, Chicago: Municipal Finance Officers Association, Government Finance Research Center, 1983.

a. Methods of Obtaining Funds and Financing

Capital expenditure surveys conducted by MARAD identified six classifications of financing sources available to ports: port revenues, general obligation bonds (GO bonds), revenue bonds, loans, grants, and others. The "other" funding category includes all funding sources not included in the broad classifications, such as state transportation trust funds, state and local appropriations, taxes (property, sales), and lease revenue. [Ref. 47:p.15] Table 5 provides a summary of the expenditure results for the period from 1973 to 1995. Future projected funding sources for the year 1995 and beyond are given in Table 6 to clarify future trends in the industry.

Based on the data from Tables 5 and 6, several comments can be made with regard to the current financial atmosphere of the public port industry. Over the entire period covered in Table 5, ports placed a greater reliance on port revenues as their primary method of financing starting in 1979, when compared to the entire period of 1973-1978. This greater reliance, along with the decline in the use of GO bonds, is a clear indication that ports have been able to generate more revenues through existing operations and that the need for outside financial support had lessened.

The shifting percentage in the use of revenue-type bonds compared to the other financing methods (Table 5) indicates that ports have been depending more on their own ability to obtain adequate financing for capital expenditures. Thus, they have relied less on government support to meet their financial requirements. [Ref. 33:p.25] However, the assumption that ports are gradually moving away from the support of subsidies toward a more self-sufficient revenue base may not be entirely correct. In the 1990s (Table 5), the category "all other" increased to a level of 22 percent from 10.5 percent a decade earlier. This category encompasses port revenues classified as loans, grants, special trust funds, and appropriations. [Ref. 47:p.15] This increase suggests that ports were, in fact, increasingly dependent on funds from other sources, and not entirely on those generated through revenues.

For the out years (1996-2000) projected in Table 6, the two most common funding sources, port revenues and revenue bonds, reverse themselves, with the highest percentage shifting toward revenue bonds. Several factors are likely responsible for this shift in funding source preferences. A shift reliance from revenues to bonds suggests that ports anticipate investing in long-term capital expansion projects that can not be financed by port revenues. A second explanation for the shift are the additional requirements for ports to initiate expansion facilities to accommodate carrier alliances and larger containerships in future years. The increase in revenue bonds also gives the impression that ports are more optimistic about their economic outlook and return on investments.

Table 5
Comparison of Financing Methods for 1973– 1995
(Thousands of Dollars)

Financing Method	**1973-1978 Survey (Percent)**	**1979-1989 Survey (Percent)**	**1990-1995 Survey (Percent)**
Port Revenues	26.7%	47.7%	41.7%
GO Bonds	30.6%	14.8%	10.8%
Revenue Bonds	29.1%	27.0%	24.9%
All Other	13.6%	10.5%	22.6%
Total	100.0%	100.0%	100.0%
Total Expenditures	**$876,326**	**$3,992,897**	**$4,660,231**

[Ref. 47]

Table 6
Comparison of Current and Projected Funding Sources

Financing Method	**1995**	**1996 - 2000**
Port Revenues	45.6%	26.8%
GO Bonds	8.5%	10.5%
Revenue Bonds	26.9%	48.7%
Loans	0.9%	0.2%
Grants	3.0%	6.3%
Other	15.1%	7.5%
Total	**100.0%**	**100.0%**

[Ref. 47]

b. Self-sufficiency and Profitability

Several studies initiated by MARAD and other port-related agencies have examined the issues of U.S. port self-sufficiency and profitability. The 1978 and 1985 reports found that there was no evidence that U.S. public ports are becoming more self-sufficient. [Ref. 48:p.1] The latest study, covering the period 1985 through 1994, the fourth in the MARAD study, suggests a decline in port profitability and self-sufficiency during the period. With few exceptions, the study also uncovered a steady decline during the ten-year period along with a consistent increase in the average operating ratio. Despite the declining trend in profitability for the end-year period in 1994, the number of self-sufficient U.S. ports (31) exceeded the number of those identifying themselves as not self-sufficient (25). [Ref. 48:p.1]

The small minority of ports that have exhibited the means and ability to become more self-sufficient have limited incentives to continue their performance. California, for example, in September 1992, passed a two-year amendment to the Public Resources Code allowing municipal governments to recoup revenues lost to the state from other initiatives from their ports - a process know as dividend stripping. [Ref. 26:p.289] Los Angeles took $44 million from the Port of Los Angeles in fiscal year 1992-1993. (In 1993-94, the amount will be capped at $25 million.) The Port of Long Beach also suffered similar consequences when the state of California took $7.9 million. (Equivalent amounts were taken in 1993-94.) [Ref. 20:pp.26-27] The practice of dividend stripping is a conflict of interest that sends mixed signals to port authorities, which previously were directed to become self-sustaining public enterprises.

B. PHYSICAL DISTRIBUTION OF PORTS

Ports and marine terminals are the key links in the intermodal logistics network supporting the nation's international trade efforts. Ninety-five percent of the nation's trade commerce flows through the ports--a vital necessity to global economic competition and national economic security. Presently, over 150 ports are operating along the three coasts

and the inland waterway system. Approximately 50 of those ports are considered major ports based on the volume of traffic throughput (measured in TEUs). In total, the U.S. port industry infrastructure operates 1,940 marine terminals comprising 3,179 berths [Ref. 46:p.19] and is charged with loading and unloading various types of commodities, passengers, and utility equipment.

Under most arrangements, ports are managed and operated through public port authority guidance. Marine terminals are operated by Marine Terminal Operators (MTOs) who lease the land and physical plant while providing cargo-handling facilities and services. [Ref. 39:p.45] Port leases facilitate the partnerships between the public- and private-sector entities that operate the port. Agreements usually require the port to lease its facilities at discounted rates to ocean carriers who, in turn, guarantee a minimum number of port calls and/or volume of traffic over the length of the contract. [Ref. 38:p.151] The rationale for such leases is based on stability and cargo promotion. That is, this type of arrangement guarantees the port a constant income stream for the duration of the customer's lease and, at the same time, gives the carrier an incentive to optimize usage because the lease guarantees discounted rates.

Although 75 percent of terminals are privately operated, [Ref. 46:p.19] a small percentage of port authorities manage and operate all of their own facilities. Savannah, Hampton Roads, Baltimore, and Charleston are state port authorities that comprise the small minority of public operators. Table 7 summarizes the U.S. seaport terminals and berths by coastal region.

Table 7
Summary of U.S. Seaport Terminals and Berths by Coastal Region

Coastal Region	Number of Terminals	Percent of Total	Number of Berths	Percent of Total
North Atlantic	417	21.5%	756	23.8%
South Atlantic	187	9.6%	343	10.8%
Gulf	493	25.4%	790	24.9%
South Pacific	221	11.4%	405	12.7%
North Pacific	260	13.4%	378	11.9%
Great Lakes	362	18.7%	507	15.9%
Total	**1,940**	**100.0%**	**3,179**	**100.0%**

[Ref. 46]

C. WATERBORNE COMMERCE

Trade has become increasingly important as exports and imports now equal about one-quarter of the nation's Gross Domestic Product (GDP). [Ref. 45:p.85] If economic prosperity is measured by the volume of tonnage handled, then the U.S. trade markets are thriving. Internationally, 1995 traffic totaled 980.1 million metric tons valued at $619.7 billion. [Ref. 46:p.9] This represents a 4.5 percent increase in tonnage and a 9.5 percent gain in dollar value over the previous year. [Ref. 46:p.10] For the same year, imports declined by 4.6 percent to 570.6 million metric tons with a value of $391.5 billion (up four percent), while exports rose by 20.5 percent to 409.5 million metric tons valued at $228.2 billion. [Ref. 46:p10] The combination of the decline in imports by 4.6 percent and the increase in exports to 20.5 percent results in an overall net positive increase of 15.9 percent for port tonnage traffic.

By all indications, the international market will continue to dramatically grow. The value of imports and exports is expected to increase from $454 billion in 1990 to $1.6 trillion in 2010. [Ref. 45:p.85] In terms of volume, the 875 million metric tons recorded in 1990 is expected to grow to 1.5 billion metric tons in 2010. [Ref. 45:p.85]

D. ECONOMIC IMPORTANCE OF U.S. PORTS

Ports have existed through the decades to promote and stimulate the economic growth of their respective regions of operation. Acting as an economic catalyst, ports promote employment opportunities and contribute significant amounts of capital to communities. On a broader scale, ports are the vital link of the international transportation system that affects world markets and balances of trade. [Ref. 45:p.106] The total economic impact of U.S. ports is realized through direct, indirect, and induced measures.

Direct measures are the more tangible measures, including the creation of jobs, personal income, sales revenue, and capital expenditures. Indirectly, port users and other

port-related economic activities input millions of dollars into the economy by providing the medium for merchants and manufacturers to distribute their goods. Also important and quite overlooked are the economic impacts induced by port activities; these can be described in terms of the "multiplier effect." The multiplier effect is the measure of re-spending that occurs through indirect and induced activity in relation to the direct port industry activity. [Ref. 45:p.108]

U.S. port activity was responsible for generating over 1.6 million jobs in 1994. [Ref. 46:p.3] This equates to the creation of one job nationally for every 1,858 metric tons of waterborne commerce moved. Furthermore, $2.30 of income is generated for each direct $1 of wages and an additional $2.50 in GDP for each direct $1. [Ref. 45:p.109] The handling of the nation's commerce was also directly and indirectly responsible for $151.3 billion in sales revenue. [Ref. 46:p.3]

Additionally, capital expenditures related to port business activities contributes, on average, $1 billion per year, a figure that is expected to increase through the year 2010, as stated previously. Figure 1 depicts the various port-related economic activities that contribute revenues into the nation's economy. Figure 2 shows that the port industry as a whole contributed more than $219 billion in tax revenues on an annual basis. Figure 3 indicates the economic contribution in terms of the direct, indirect, and induced economic measures.

In total, the port industry and port users generate more than 15 million jobs and add some $780 billion to the GDP annually. [Ref. 4:p.71] Table 8 provides a summary of the overall economic impact of the port industry, its port users, and capital expenditures.

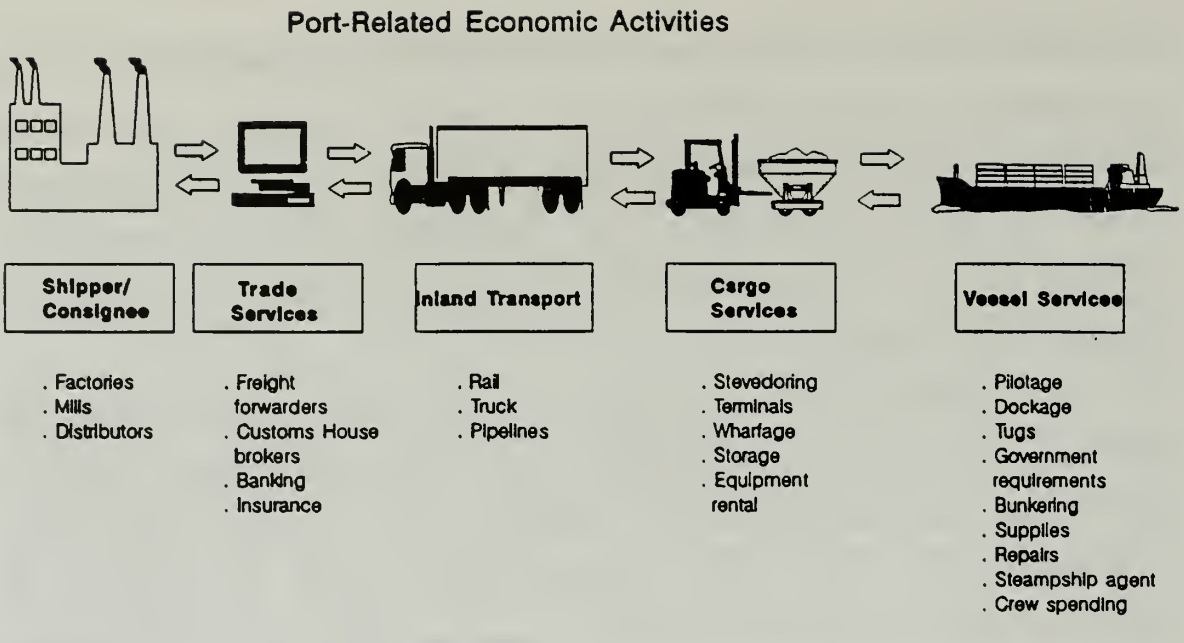


Figure 1. Port-Related Economic Activities [Ref. 45]

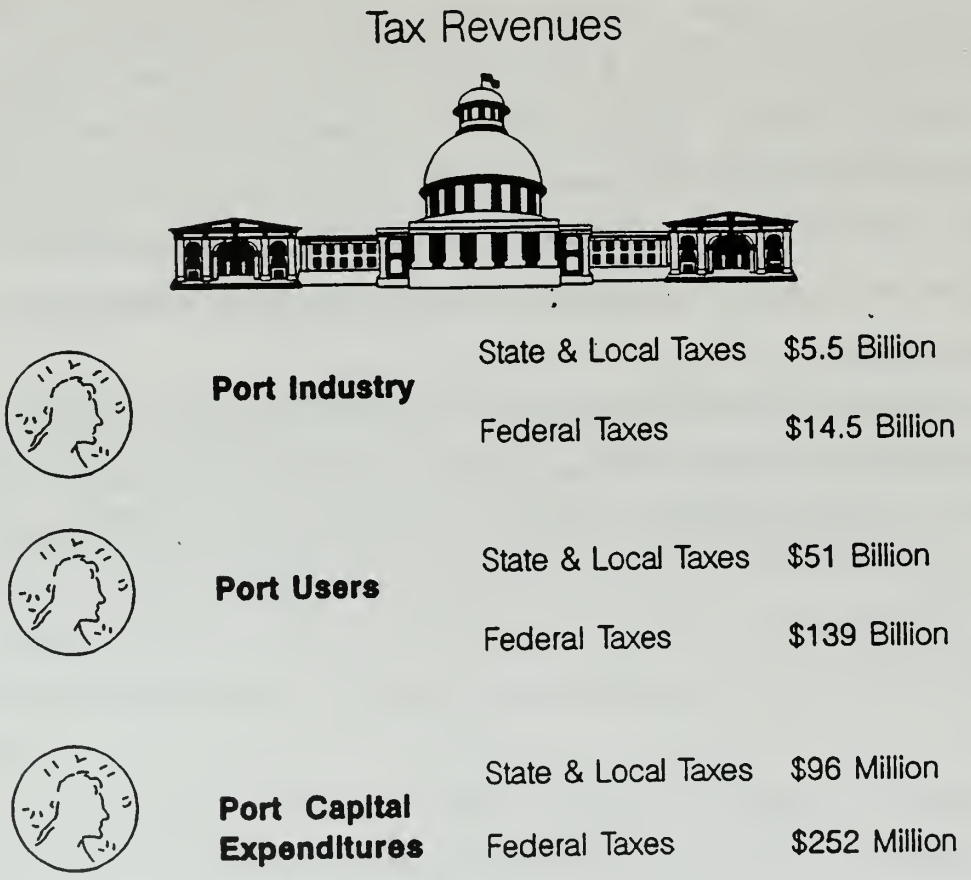


Figure 2. Tax Revenues [Ref.45]

TOTAL IMPACT

	DOMESTIC	FOREIGN	TOTAL
Cargo	1.99 Billion MT	897 Million MT	2.887 Billion MT
Jobs	743,473	796,752	1,540,225
Income	$25 Billion	$27 Billion	$52 Billion
Sales Revenues	$68 Billion	$71 Billion	$139 Billion
GDP	$36 Billion	$38 Billion	$74 Billion
Taxes	$10 Billion	$10 Billion	$20 Billion

DIRECT IMPACT

INDIRECT AND INDUCED IMPACT

	DOMESTIC	FOREIGN	DOMESTIC	FOREIGN
Cargo	1.99 Billion MT	897 Million MT	1.99 Billion MT	897 Million MT
Jobs	176,736	192,352	566,741	604,400
Income	$ 7.5 Billion	$ 8 Billion	$17.6 Billion	$18.7 Billion
Sales Revenues	$20.3 Billion	$21 Billion	$47.5 Billion	$50.4 Billion
GDP	$10.6 Billion	$11 Billion	$25.4 Billion	$27 Billion

Figure 3. Total Impact, Direct Impact, Induced and Indirect Impact Ref. 45]

Table 8
Summary of the Port's Economic Impact for 1994

	Total Impacts	Port Industry Impacts	Port User Impacts	Capital Expenditure Impacts
Employment	15.9 mil	1.6 mil	14.3 mil	28,200
Income	$515.1 bil	$56.3 mil	$457.8 bil	$962.3 mil
Sales	$1,623.2 bil	$151.3 bil	$1,469.7 bil	$2.2 bil
GDP	$783.3 bil	$78.6 bil	$703.5 bil	$1.2 bil
Taxes-Federal	$154.3 bil	$15.5 bil	$138.6 bil	$248.2 mil
Taxes-State & Local	$55.8 bil	$5.9 bil	$49.8 bil	$99.3 mil

[Ref. 46]

E. U.S. PORT INDUSTRY CONCERNS

The port industry faces an ever-increasing number of complex issues and challenges to manage in the upcoming decade. With international trade expected to double in a period of less than ten years, many ports will be forced into tough decisions that will affect their ranking within the industry. Port authorities are devoting considerable time and resources to resolving their primary concerns: port development, financing, and revenue generation; environmental regulation; intermodal land transportation access; next-generation container ships; and global shipping alliances. Dredging is also a major issue for ports given channel restrictions and increasing ship drafts.

As a result of the extensive list of concerns, each with different stakeholders in some cases, port authorities find it difficult to prioritize their problems in any logical order. Higher prioritization of certain concerns over others can make the port vulnerable to competitors in other areas. The key is to find a balance among customer demands, the port's available capital resources, and the strategic goals and objectives.

Since the majority of the problems facing ports today are attributable to the introduction of larger vessels and alliances, it makes sense to address these issues first. These two factors are the catalyst for a myriad of associated problems which will cause significant restructuring and expensive capital expenditures in U.S. public ports. Because of budget shortfalls, rising costs, and decreasing revenues, many ports now find themselves financially and institutionally unprepared for the challenges of improving productivity and throughput and relieving congestion.

The industry concerns do not necessarily signal the end of business for many ports. Several ports (the successful ones) have found ways to address and resolve these issues. Sound strategic planning and good financial management of resources are two elements of success.

F. CONCLUSIONS

According to John Reeve, vice-president at Mercer Management Consulting, "To be a good port of choice [for the new ships], you will need good productivity, good labor relations, a large local market, and a fairly significant cargo hinterland." [Ref.31] Based on available financial data, several U.S. public ports fit the criteria of a good port. They are integral partners in global and domestic trade infrastructure, serving as a transfer point for a significant portion of the nation's international commerce.

Yet, despite their worth, certain markets (ports) within the industry are struggling to remain competitive and develop into self-sufficient public enterprises. In the absence of government oversight, port authorities must act on their own behalf to resolve issues which impact the entire national trade balance. Only recently have the issues of port congestion and landside access problems received the attention of several government agencies, which, in turn, have initiated studies and conferences to address these concerns.

To their credit, port authorities are now realizing they must take a firmer position in identifying alternative funding sources, negotiating equitable contracts, and other areas to ensure their own success. Because so many of their obstacles are interrelated,

collective efforts on behalf of the industry should be instituted to build regional or political alliances to confront these issues. Competitors are pooling resources and developing partnerships to gain a competitive advantage in the industry; therefore, port authorities should adopt some of the same practices.

The following chapter delves into three main factors responsible for the changing waterfront structure of U.S. ports: competition in ocean transportation, next-generation container ships and the emergence of carrier alliances. The chapter also will examine the implications of these factors for U.S. ports.

III. DEVELOPMENTS IMPACTING U.S. PORTS

A. INTRODUCTION

Against a backdrop of expanding international trade and steady growth rate in containerization, the economic outlook for most shipping lines (carriers) would seem rather optimistic. However, a closer examination of the situation reveals an industry preoccupied with issues of excess capacity, declining profit margins, and organizational restructuring. All of these factors, in addition to other secondary issues, have contributed to an intensely competitive environment. Attempting to satisfy the competitive pressures of the environment will place carriers in the position of choosing between two opposite philosophies to follow. Carriers can take a more subtle approach and wait for business to escalate, or they can aggressively capitalize on the potential gains of increased tonnage traffic by initiating activities to promote business.

Economic indicators suggest that, in only a few short years, traffic tonnage will grow by several million tons, bringing much-needed revenue into the industry and potentially providing limited economic relief for many carriers. However, it is quite obvious that expansion in traffic volume can only be covered either by increasing the numbers of strings operated (frequency of service) or by vessel upsizing. In some cases, it may be practical do both, but the decline in freight rates creates pressures to go for the lower costs that come from upsizing. [Ref. 32:p.201] For many carriers, who have little disposable capital to divert into the procurement of new vessels and increasing service levels, few courses of action are available to remain competitive.

From the carrier's perspective, the most practical course of action will be to transition into larger ships operated by alliance arrangement frameworks. Working in tandem, this partnership will enable carriers to take advantage of the economies of scale of larger vessels, while pooling resources to reduce operating costs. Unfortunately for

other components of the maritime infrastructure, any practices implemented by carriers will impact every facet of their operation. Likewise, port operations are not immune to these changes, and the introduction of larger vessels and alliances will compound the existing problems of landside accesses, port congestion and productivity, and shortfalls in technology. In most cases, the changes will result in additional financial and operational burdens for many ports struggling to remain competitive.

This chapter will examine the developments impacting U.S. ports and the resulting competitive pressures being exerted. This chapter will also discuss the responsive actions being taken by carriers to remain competitive within the container shipping industry.

B. COMPETITION IN OCEAN TRANSPORTATION

Historically, shipping lines have tried to maintain price controls through conferences (i.e., agreements) among carriers on the terms of transport among lines serving any given markets. [Ref. 10:p.290] For instance, conference lines serving particular markets, such as the U.S. East Coast to North-west Europe, or Japan to the U.S. West Coast, continue to establish common rates for a large number of commodities. [Ref. 10:p.290] In the past, conferences have also attempted to exert their presence by controlling capacity and entry into conferences along designated routes. However, this power has long since been broken, partly by legislation, and as a result of fundamental changes in technology and international trade. In particular, with the advent of the U.S. Shipping Act of 1984 there is far greater flexibility in rate structure with considerable scope for negotiated rates and service contracts. [Ref. 10:p.290]

1. Shifting Roles of Conferences

Today, conferences still play a major role in many markets, although emphasis has now shifted to the stabilization of rates and capacity. The significance of the Shipping Act, signed into law by President Reagan on March 20, 1984, was the

deregulation of the ocean transportation industry. Specifically, the Shipping Act reduced the regulatory burden of ocean carriers by: (1) authorizing service contracts, and intermodal and time volume rates; (2) permitting independent action on rates and service by conference members; (3) expediting the review process of agreements by the Federal Maritime Commission; and (4) broadening the antitrust immunity (and, therefore, reducing the regulatory burden of antitrust laws) of the collective action of ocean carriers. [Ref. 38:p.147] The Shipping Act of 1984 not only gave ocean carriers the right to function in an environment of free and open competition.

A primary goal of the Shipping Act was to provide an efficient and economic transportation system in the ocean commerce of the U.S. [Ref. 38:p.147] The means for achieving this efficient transportation system is through the promotion of competition among the transportation components in the intermodal network. [Ref. 38:p.148] As a result of this legislation and the operation of many lines referred to as "independents" (such as ZIM and COSCO), the conferences have only been partially successful in maintaining rates, which have remained flat or even declined in many instances. [Ref. 10:p.290] The independent lines operate outside of the conferences in many cases. They are not entirely independent of the conference rate structure, since they typically offer rates 10 to 15 percent below whatever the conference may be. [Ref. 10:p.290] In some instances, independents serve as a constraint on the conferences.

In recent years, as conferences have tried to regain some lost ground in attempting to stabilize rates, capacity problems have become endemic. [Ref. 10:p.290] The capacity problems have meant that conferences cannot establish rates that hold up very long, and periodic adjustments must be made at the inconvenience of everyone. [Ref. 10:p.290] The result has been a new form of arrangement, the so-called "conference agreement." [Ref. 10:p.290] In these agreements, participants come from both conferences and non-conference lines, and their strategy focuses on withdrawing capacity on certain routes and shifting to more profitable trade routes with greater economic longevity. Being able to shift trade routes as the market dictates not only gives carriers flexibility, but also allows

them to offer a higher level of service while keeping costs at a minimum. In the competitive market of ocean transportation, these operational tactics provide the participants with a strategic advantage over their competitors.

2. New Entrants into the Market

The capital costs of setting up and operating a profitable container service along certain routes are extremely high since, in addition to investing in vessels, it is necessary to establish major land-based operations to serve the intermodal dimensions of container shipping. [Ref. 38:p.290] In attempting to deliver optimum levels of service, carriers seek to provide weekly ports of call, which may require between six and twelve vessels just to obtain an acceptable schedule.

Given the high entry thresholds of the industry and the economic status of certain carriers, one might assume that entry into container shipping markets would be difficult, thus leaving an abundance of business for well-established carriers. This is not the case. With the projected growth in tonnage traffic, new actors are now entering in the hopes of obtaining a profitable share of the market. The traditional carriers who dominated the early period of containerization, such as Sea-Land, APL, P&O, Maersk, CGM, K-Line, MOL, and OOCL, have been joined by aggressive new actors mainly from East and South Asia, such as Yanging, COSCO, MSC, Evergreen, and Hanjin. [Ref. 10:p.290]

Their entry into the market has augmented competition and forced the traditional carriers to become more competitive both in rate structure and service levels. One of the most overlooked factors contributing to competition in the industry has been the emergence of these aggressive new shipping lines and small independent operators. Their entry, to some extent, has hastened the process of pushing dominant carriers into alliances to strengthen their position in the industry.

3. Miscellaneous Factors

In addition to the decline in the conferences and entry of aggressive independent carriers, other factors have led to increased competition in ocean transportation. To be competitive on any scale requires not only a certain number of ships to ply trade routes, but also a supporting land-based infrastructure. Given the high thresholds of entry previously discussed, the question remains: how are shipping lines finding the assets to operate?

One explanation is that the expectation that older, smaller container ships would be scrapped as the larger vessels came into service is not being fulfilled. Instead, these ships are being acquired by other operators competing along profitable routes against the traditional carriers and in niche markets. Their presence in the market creates pressure to keep rates low and aggravates the surplus problems. Excess capacity means there are more carriers than needed to move the available cargo; the result is increased competition.

Advancements in technology have also fueled competition in the industry, with some carriers using technological improvements to gain leverage. These improvements have come in the form of larger container ships, automated terminals, and electronic data interchange (EDI). Technology forces carriers to keep pace with rival carriers in every aspect or run the risk of losing clients.

The next two sections will examine the use of next-generation container ships and carriers' alliances, both responses to the competitive pressure in the industry.

C. NEXT-GENERATION CONTAINER SHIPS

The transition into larger vessels is demand driven. Carriers operating under competitive pressures must have a way to meet increasing capacity requirements without increasing costs. Since 1957, when the first containerized vessel was launched with a carrying capacity of only 396 TEUs [Ref. 39:p.26], the industry has responded to

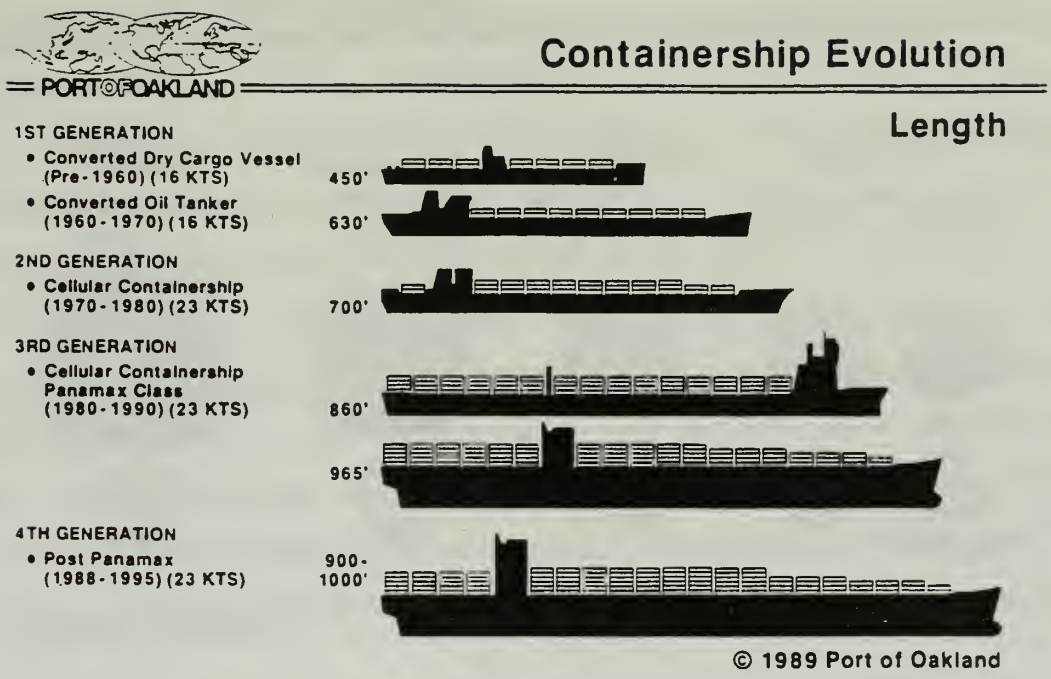
demands of increasing capacity by introducing larger vessels. This philosophy has changed little in the past forty years. Larger container ships, from the standpoint of carriers, are one of the best alternatives for meeting market demands of providing greater carrying capacity within the constraints of their operating budgets.

1. Evolution of Containerships

The evolution of containerships has often been described in terms of generations, with each succeeding generation characterized by larger and more efficient ships than its predecessor. The first containerships were merely converted dry cargo break bulk ships or tankers carrying containers. Today's state-of-the-art containerships are capable of carrying over 6,000 TEUs, more than 15 times greater than the capacity 40 years ago.

Aspects of the first through fourth generation of containerships are depicted in Figures 4 and 5, including the progressive increases in length, beam size, width and carrying capacity. The first generation containerships were no more than conversions that operated from 1960 to 1970. This generation was succeeded by second and third generations, which differed in speed, motive power, and capacity. Second-generation ships (1970 to 1980) were the first attempt to design ships that incorporated the characteristics of both increased carrying capacity and speed to take advantage of economies of scale. Third-generation ships (1980 to 1990) were referred to as "panamax" container ships because they were just able to pass through the Panama Canal.

Fourth-generation ships (1988-1995) were of the post-panamax size, capable of obtaining speeds of 23 knots with a carrying capacity of 4,000 - 5,000 TEUs. The size of the fourth generation ships prevents them from using the Panama Canal. This generation, unlike previous ones, concentrated on automation, not solely from an engineering standpoint, but also in improving loading and unloading times to reduce time spent in port. The rationale behind this emphasis is that, as ships became larger, the capital costs



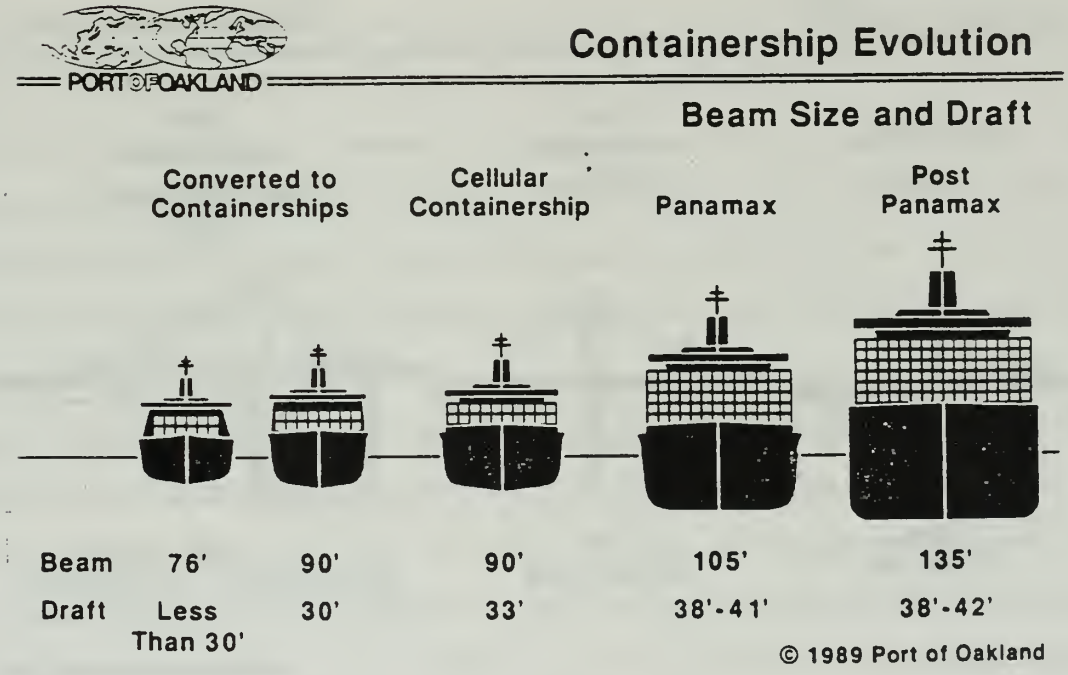
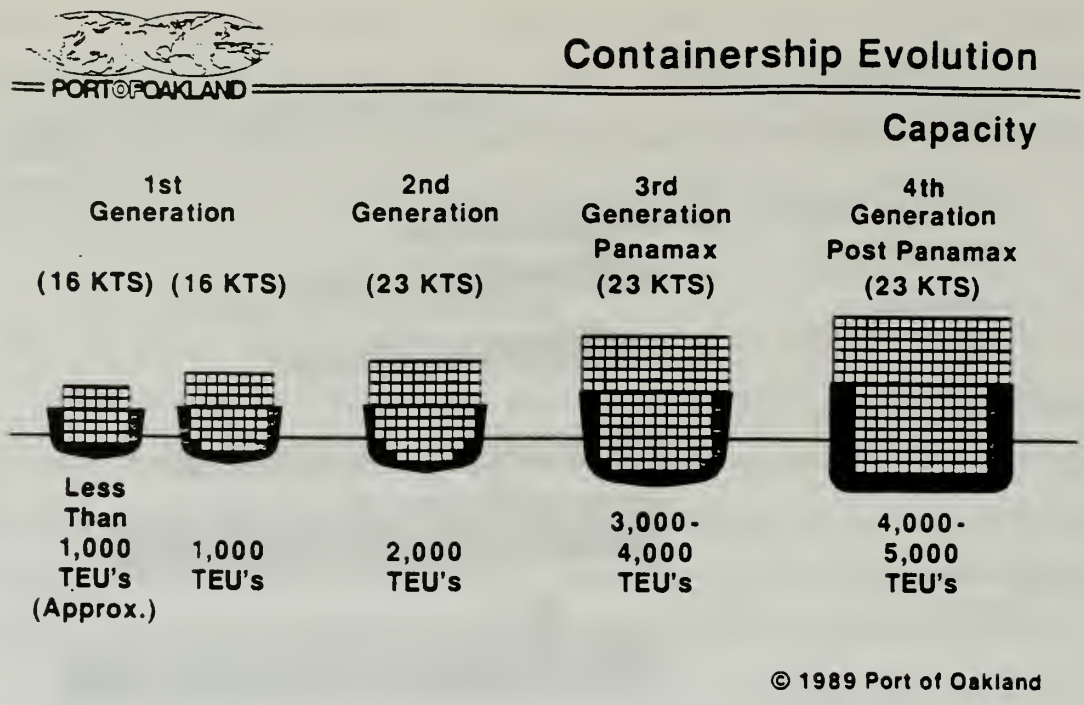


Figure 4. Containership Evolution - Length [Ref. 33]



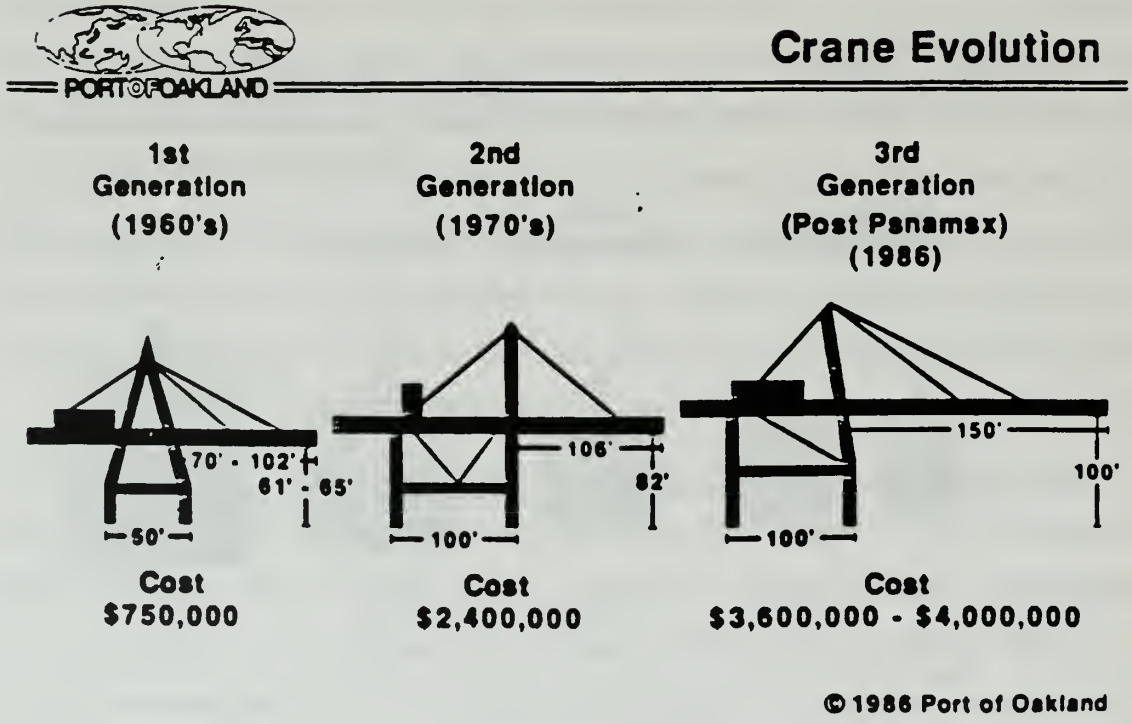


Figure 5. Containership Evolution - Capacity [Ref. 33]

become so immense that it becomes mandatory to keep the ship moving (at sea, instead of in port) as much as possible to create revenue.

Currently, the industry is in the fifth generation of containerships or the post-panamax plus era. Fifth-generation ships generally have a carrying capacity of 5,000 to 6,000 TEUs, a displacement of 40 feet, and service speeds of 23 knots or more. The newest entrants to the market are variants on fifth-generation ships known as "mega ships" or next-generation containerships because of their increased dimensions compared to fifth generation ships. The newer container ships not only achieve added carrying capacity, but they also offset expensive operating costs and counter competitive practices by rival carriers operating within the same markets. The question of whether or not ship size will continue to increase into the out years will be elaborated on in the next section.

2. Rational for Next-Generation Container Ships

The new 6,000 TEU vessel, Regina Maersk, launched on January 10, 1996, in Maersk's Odensa shipyard in Aarhus, Denmark, signaled the container ship carriers' quest for scale economies, automation, and gigantism. [Ref. 12] At 1,044 feet (318.24 meters), the new Maersk ship is longer than the Eiffel Tower, but is still capable of obtaining speeds of 25 knots. Its total compliment of officers and crew of 15, compared to 21 for 4,000 TEU vessels, indicates that potential areas for cost savings include crew reductions.

Enticed by predictions of eight- to ten-percent growth in container trades, carriers will attempt to deploy entire fleets of 4,800 to 6,000 TEU container ships over the next years - primarily in trans-Pacific lanes. [Ref. 31:p.49] Some perceive the 6,000 TEU container ships as potential long-term solutions to offset declining profits and reduce operating costs. A recent report published by Drewery Shipping Consultants suggests that operators could expect savings of six to twenty percent from a 6,000 TEU vessel

compared to a 4,000 TEU vessel. [Ref. 11:p.10] The new container ships are expected to achieve these savings primarily by reducing inport time pierside, calling on fewer ports, and automating shipboard functions. Because of the enormous expense of operating a larger vessel, carriers will be careful to introduce them only when the economies of scale can be fully exploited.

The six points summarized in Figure 6 are the key objectives that carriers hope larger vessels will allow them to achieve. These points represent only one viewpoint, however. Some carriers have not bought into the argument that building larger vessels translates into greater efficiency. Their reluctance centers around the debate as to whether or not the demonstrable gains of bigger ships will erode or be eliminated by additional landside costs incurred by the ports catering to these vessels.

6,000 TEU: What's the point?

(1) Independent sources have suggested that 6,000 TEU post-panamax vessel could be 20 percent more efficient in terms of operating costs than a 4,000 TEU panamax liner;
(2) This translates into a 6 percent difference in unit cost;
(3) Some of the principal savings to be made include the ability to move 50 per cent more boxes with the same crew costs, and with approximately the same level of fuel consumption, per container;
(4) Once in port, other savings would come from reduced port and canal fees, including towage and pilotage, per container;
(5) Fewer ships with a much larger capacity would also reduce ship repair, insurance and maintenance costs;
(6) A smaller fleet with larger capacity would also reduce management and administration

Figure 6. 6,000 TEU: What's the point? [Ref. 11]

Despite the legitimate concerns over the introduction of next-generation container ships, carriers are proceeding with orders and efforts to integrate them into existing operations. Based on current order requisitions, spending projections were to approach

$3.8 billion on the procurement of larger ships in 1996 and $4.9 billion in 1997. (These figures includes all vessels 2,500 TEU-plus.) [Ref. 13] Appendix A is a listing of projected container ship orders placed by carriers for ships in excess of 4,900 TEUs.

3. Future Trends of Container Ships

When will trends in vessel upsizing stabilize? Because the deployment of larger ships is only in the initial stages, it is too soon to evaluate their utilization based on performance trends. The available literature suggests that the equalization in balance between supply (carrying capacity) and demand (projected tonnage) will likely not occur until the turn of the century. According to a forecast by Temple, Baker, and Sloane, Inc., if future orders roughly equal capacity eliminated by the removal of older containerships during the 1990s, demand caused by growing international trade will just about catch up with the supply of ships by 2000. [Ref. 32:p.2] Until these two factors reach an long-term equilibrium point, the deployment of larger vessels will likely continue, and the potential for upsizing will continue to exist.

Of the estimated 84 post-panamax ships afloat or on order, 50 were in batches of five or six, a number suggesting use on 35 to 42-day trans-Pacific round trip voyages, at least initially. [Ref. 14:p.54] In comparison to other trade routes, weekly service loops in the Europe/Asia trade requires eight or more ships, and the Atlantic trade route is too small for the larger vessels. The future utilization of the larger ships will likely concentrate along the trans-Pacific routes.

Shipping lines are presently investigating the feasibility of introducing even larger- capacity 8,000 TEU and 15,000 TEU ships into the market in upcoming years. Table 9 shows a comparison of the 15,000 TEU dimensions with the smaller 6,000 to 4,000 TEU ships. As evidenced by Table 9, the physical dimensions of the proposed 15,000 TEU container ship are considerably larger than those of any earlier generations.

D. THE EMERGENCE OF CARRIER ALLIANCES

A new approach to world logistics has become a reality through the mechanism of "global shipping alliances." [Ref. 46:p.45] Although many carriers have actively participated in joint partnerships with their competitors, the new prevailing agreements exceed the scope of mutual cooperation and integration that existed before. Conferences are any type of formal or informal agreement between shipping companies, usually in liner trades, that restricts competition and is designed to secure regularity and frequency of service, and stability of rates. An alliance is a consortium or a sharing agreement among a group of shipping lines serving similar trade areas for their mutual economic benefit. [Ref. 46:p.45] Global shipping alliances were established to reduce operating costs by coordinating their fleets and terminal operations across their trade routes.

Table 9
Comparing Containership Dimensions

	15,000-TEU concept	6,000-TEU Regina Maersk	6,674-TE P&O orders	4,000-TEU typical Panamax
Beam	226 feet (69 meters)	140 feet (42.8 meters)	140 feet (42.8 meters)	106 feet (32.2 meters)
Length	1,312 feet (400 meters)	1,044 feet (318 meters)	984 feet (299.9 meters)	958 feet (292 meters)
Draft	46 feet (14 meters)	46 feet (14 meters)	44 feet (13.5 meters)	43 feet (13 meters)
Rows across	28	17	17	13
Engine HP	180,000	74,640	N/A	46,800

[Ref. 14]

For example, a containership operated by an alliance will share or charter space among its members. [Ref. 46:p.45] This will increase vessel load factors and reduce the number of vessels needed on a trade route, which will lower operating costs for the alliance shipping partners. [Ref. 46:p.45] The emergence of carrier alliances is an opportunity for carriers who desire to increase the net profit per TEU carried and raise frequency of service. The utilization of carrier alliances will continue to escalate as carriers seek new ways to leverage scale and service factors.

1. Rationale Behind Alliances

Under most circumstances, many companies would resist the decision to relinquish autonomous control over operations in order to forge new partnerships. However, with the changing global markets' demands for additional capacity and the need to offer more frequent service, these new partnerships are a matter of survival, not company preference. Reports from Mercer Consulting [Ref. 18] suggest that the inherent instability of rates and the changing nature of the global shipping market make it difficult for carriers to sustain a reasonable rate of return for their investments. They add, "In this fiercely competitive business, one key to survival is seeking every opportunity to lower cost structures. . . . [Alliances] are the next logical area for carriers to look to lowering their costs while still delivering greater service." [Ref. 18]

For many carriers who want to expand services into the Pacific Rim countries and other markets, but do not have the extensive capital backing required, alliances are a sound alternative. Because carriers want to remain competitive, they have set out to use the alliance framework as a means to reach overall industry goals:

1. reverse the trends of declining profit margins
2. reduce operating costs in order to allow for expansion of services with limited capital investment

a. Financial Issues

Today, relatively few industries would be able to remain in operation with the high fixed costs and low rate of return found in container lines. Research conducted by the *American Shipper* [Ref. 13] reveals that the median operating margin (as a percentage of total revenues) among 31 shipping groups or subsidiaries was just six percent in 1995. Net profit margins fared no better, yielding only three percent of total revenues.

Unlike the retail industry (shippers), where margins are low but inventory turnover is very high (thereby increasing return on assets), shipping combines low net margins on revenues and the requirement to own high levels of assets, particularly fixed assets. [Ref. 13:p.48] This requirement makes the task of generating positive profit margin difficult in comparison to other industries. On average, shipping companies must own at least $1.20 of assets to generate $1 of sales.

To bring this issue into perspective, consider the carriers' profits compared to those of some international shippers (DuPont, Toys "R" Us, Heineken, BASF, and Unileve). Disproportionate ratios like the ones exhibited below make generating profits a difficult challenge for most carriers.

1. Average net profit as a percentage of revenues is 1.4 percent for carriers versus 6.1 percent for shippers.
2. Average net return on total assets is 1.2 percent for carriers versus 7.0 percent for shippers.
3. Average net return on equity is 5.7 percent for carriers versus 20.6 percent for shippers.

b. Competitive Response to Financial Situation

In the container shipping industry, as well as in other international industries, a decline in profit margins is not a signal to abandon ship or call for the

reengineering of the organization. It simply indicates that operating costs are pacing ahead of revenues. This is the case for many carriers - their profit margins are dwindling, but overall revenues are increasing. For example, for the period 1978-1996, one industry study of eleven major carriers concluded that as ratios of both assets and revenues, profits of only 0.4 percent were realized. [Ref. 13:p.50] In contrast, within that same time frame (1995), carrier profits rose 15 percent, to $40.6 billion. [Ref. 13:p.50]

Even though the industry has made slight economic gains, attributable to alliances taking advantage of economic partnerships, operating costs still remain relatively high. The consensus cause for the narrowing gap of profit margins is the net profit per TEU received by carriers. The *American Shipper* study mentioned above indicated that the average carrier net profit per TEU carried was $35 - a small commission for the cost of operating. The industry response to this issue has been the movement toward alliances and deployment of larger container ships to assist in reducing costs.

Industry wisdom is that global operating alliances should produce savings of approximately $100 per TEU moved per year. [Ref. 5] If these cost-saving measures are effective, then the trend of declining profits should change.

2. Changes in Carrier Organization Structure

The possibility of continued dwindling profit margins is a high-priority issue for carriers. For most, the common response to the economic pressures has been the coming together of shipping lines in a variety of associations. The purpose of associations is characteristic of other industry partnerships between competitors - cut costs and become more efficient. Firms come together to exploit geographical markets, and to share risks and profits. The days of independent operation for the majority of carriers are over, and the new alliances are reshaping the carrier organizational structure.

In the shipping industry, alliances are taking many forms, and strategic alliances must be recognized as integral parts of the container shipping business. Ocean carriers

have participated in some form of joint endeavors with competitors for several years in order to achieve mutually beneficial financial objectives. Cooperative agreements known as consortia are one example of this tactic employed by carriers. A consortium is a group of ocean carriers that share space on each other's ships and offer a joint service in a particular trade. [Ref. 18:p.65A]

Other types of joint operations reflect the more traditional definition of strategic alliances, in which several lines jointly offer a growing number of services on the trans-Pacific trade routes. Alliances can be described as "consortiums with a twist." [Ref. 18:p.65A] Unlike a consortium, an ocean carrier alliance can practically be global in scope, covering every trade its members ply. [Ref. 18:p.65A] Furthermore, they go well beyond simple space sharing agreements to include the sharing of containers and chassis, terminal facilities, and even inland and feeder operation services. The lines facilitate this arrangement under agreements known as vessel-sharing agreements (VSA).

The frameworks of VSAs are more encompassing than consortium agreements, with each line contributing a number of ships required to maintain an acceptable level of service frequency. VSAs allow the participating lines the opportunity to extend their resources without additional costs. The VSA focuses on larger vessels, and since these vessels are also the newest, the smaller older ones are forced out of business or into operation along other trade routes. [Ref. 45:p.101] Also, VSAs are resulting in calls at fewer ports, indicating that carriers will seek geographic-specific load centers as central points for their operation. Contrary to conference agreements, which are somewhat regressive to the industry, VSAs appear to maximize capacity and operations without interfering with price mechanisms. [Ref. 45:p.101]

The latest versions of alliances are the increasingly popular "global shipping alliances." Global shipping alliances distinguish themselves from all other types of alliances by the level of scope and depth of integration they aim to achieve among partners. Global alliance agreements meet and surpass previous forms of agreements by including specific clauses within their written contracts pertaining to specific functional

responsibilities and equal sharing of some related operational costs. The most significant innovation of these global alliances is their aim to integrate electronic data interchange (EDI), equipment, terminal and inland or intermodal operations.

3. Projected Trends for Alliances

Where the all the cooperation among ocean carrier alliances is heading is still uncertain. The trends of the industry are directly linked to the anticipated growth in tonnage traffic and successful deployment of larger container ships. If conditions remain favorable, and demand for increased capacity continues in the upcoming years, all indications are that carries will seek to continue developing alliances. In particular, they will look towards greater integration of services and resources to drive costs down while generating greater profits. The global alliance members are discussing the possibility of jointly purchasing fuel and equipment, as well as a uniform ship design on certain trade lanes [Ref. 18:p.69A] aimed at keeping costs to a minimum.

Continued sharing of joint commitments on the part of carriers provides a natural progression to mergers between carriers within an alliance. By merging container shipping lines, one company has responsibility for ownership, management, and operations of the properties previously operated separately. Mergers are the next logical transition for carriers who hope to acquire further shares of the market in the midst of high operating costs.

The future direction of alliances will ultimately rest with the level of performance of the next generation of container ships. Carriers have made clear their intentions to use larger ships as a primary means of accomplishing the objectives of the alliance framework of operation. Therefore, if larger ships are compatible with the existing port operating environment, alliances will continue to be an integral component of ocean transportation. If, however, they prove inefficient, the future trend of alliances will lose momentum, and some carriers may return to independent operation.

E. CONCLUSIONS

Given the certainty of growth in international trade by the turn of the century, it seems certain that the emerging developments discussed in this chapter will have impact on U.S. ports - the question is to what extent. Competition within the industry will justify the use of next-generation container ships by emerging carrier alliances to exploit the economies of scale and take advantage of the growing international trade market. Furthermore, the introduction of larger container ships is perhaps the most significant development to impact the port industry. The success or failure of the larger ships will determine the strategies carrier alliances will follow and determine the extent of operational strains to be placed on ports.

There are limitations on the influences that next-generation container ships and carrier alliances will have on the port environment. Vessel upsizing can not continue to be the shipping lines' answer to resolving their financial problems. Ports will not be able to keep up the pace of facility expansions without identifying long-term sources of capital. The competitive environment does call for measures to ensure survival, such as the collaboration of principal players working toward common objectives, and resolving the impediments to (organizational) effectiveness discussed in the next chapter.

IV. IMPLICATIONS FOR U.S. PORTS

A. INTRODUCTION

U. S. ports are not oblivious to the implications of the competition in ocean transportation, the next-generation containerships, and the carrier alliances discussed in chapter III. These three factors will necessitate, at a minimum, improvements in terminal efficiency and access routes (landside and waterside) to expedite the movement of cargo within the ports. Ports will also be required to dredge deeper channels, modernize existing facilities and material handling equipment (MHE), alleviate port congestion, and address other productivity issues. The research for this thesis indicates that the overwhelming concern among individuals in the port industry are the effects of inefficiencies in productivity. For most ports, productivity issues will the greatest obstacle to overcome because of the projected surge demands of larger containerships.

In addition to the increased demand requirements, the deployment of larger vessels will have a chain-reaction affect on every aspect of the port and intermodal network stretching productivity capabilities to the maximum. Furthermore, the complexity of the problems for U.S. ports will not allow for any quick or easily identifiable resolutions to the potential problems. In particular, port congestion and channel dredging are influenced by multiple stakeholders, each with a different perspective on the issues.

It is necessary to examine the impediments to (organizational) effectiveness for several reasons. First, port authorities must confront these potential problems if they wish to remain competitive and offer an acceptable level of service that will not only attract new clients, but also retain their existing clientele. Global shipping alliances will only seek out the most efficient ports with adequate infrastructure to support the deployment of next-generation containerships. Maintaining a competitive advantage will

additional capital expenditures to expand facilities and enhance productivity with new technological advances.

Second, it is important to draw attention to the scope of problems currently facing the port industry. Many of the existing problems are direct results of outside influences (such as environmentalists or community groups) who are in direct opposition to any improvement/expansion efforts initiated by ports in their communities. Lastly, the impediments to (organizational) effectiveness directly influences DoD's interface with U.S. ports during military deployments. If the potential problems are not addressed, DoD may experience unnecessary delays in accessing ports and further contribute to the congested port yard space. Both of these factors will ultimately reduce DoD's effort to rapidly deploy military units in response to national emergencies.

This chapter is concerned with the implications for U.S. ports due to the changing maritime industry as typified by the next-generation containerships and carrier alliances. Impediments to port organizational effectiveness are addressed in the next section followed by opportunities for port improvements.

B. IMPEDIMENTS TO (ORGANIZATIONAL) EFFECTIVENESS

The port industry faces an array of challenges which have the potential to slow the throughput of commodities and restrict access (landside and waterside). The size of the larger containerships also presents certain constraints to productivity. The larger ship draft exceeds the depths of most harbor channels and strains the capabilities of existing MHE. Even if ports are successful in overcoming these constraints, as public enterprises they are bound to act in the best interest of the stakeholders, some of whom may be antagonistic towards "port improvements." Despite the best developed long-range strategic plans of many ports, if they fail to take into account the interests and concerns of the stakeholders their plans will not be successful.

This section examines the impediments that have the greatest potential for impacting port efficiency and productivity.

1. Operational Constraints

In terms of constraints, U.S. ports will be hampered in two critical areas: infrastructure limitations and fiscal powers. While some ports will be able to afford the technology needed to maximize effectiveness, many will find these improvements cost-prohibitive. The projected rapid growth in international trade has created a "good news – bad news scenario for many ports operating in North America." [Ref. 19] The good news for ports is that a certain number of them will enjoy record volumes of cargo passing through their gates. The bad new is that ports are finding it increasingly difficult to meet the growing demands for greater capacity, productivity, and speed placed on them by ocean carriers, importers, and exporters. [Ref. 19]

Many ports that would like to meet their customers' demand simply cannot do so because of infrastructure limitations. Next-generation containerships, merely by their dimensions present constraints for many ports. First, traditional cranes used at terminals do not have the necessary reach capabilities to access containers onboard the larger vessels. Therefore, in order to offload and unload cargo efficiently, ports will have to invest in multi-million dollar cranes. Second, the anticipated volume of cargo to be discharged by larger ships places additional stress on the port's intermodal connections by creating severe port congestion problems. The larger vessels (6,000 and 7,000 TEU capacity) can generate an average of 9.6 unit trains, as compared with the post-panamax vessels, which generated only 6.6 unit trains of container cargo. [Ref. 19:p.33] Combine this train activity with the number of inbound and outbound trucks transferring cargo, and the terminal yard and surrounding areas can be a congestion point for several hundred containers.

Even if cargo can be offloaded successfully, the number of containers may exceed the available amount of storage area in yard spaces. For containers that are ready for immediate transfer into the intermodal transportation system via rail and truck, there are constraints that prohibit this process - lack of on-dock rail facilities and landside access, both of which will be elaborated on in later sections of this chapter.

To minimize the constraints, ports must invest capital in new MHE, automation and technology, and the expansion of existing facilities. Continued investment in capital expenditures, as discussed throughout this paper, is the subject of much debate because port authorities are skeptical about getting a guaranteed return on their investment. The questions still remains: where will the capital come from to address these operational constraints facing many ports? Chapter II (subsection on Port Development Finances and Revenues) provided a detailed analysis of the fiscal constraints affecting U.S. ports.

2. Stakeholder Pressures

Improving the quality of service at U.S. ports requires the collective cooperation of many different stakeholders. Figure 7, a generic stakeholder map for the port industry, shows the number of groups and special interests who must be accounted for in issues relating to port activities. The term "stakeholder" applies to those individuals, groups, and organizations who affect or have potential to affect the operation of a given organization. In the port industry, there are numerous stakeholders, each with its own opinions and agenda regarding port affairs.

The port industry is particularly vulnerable to stakeholders because port activities overlap into many areas of public interest. For example, the geographical location of ports places port authorities at odds both with commercial developers desiring to revitalize city waterfronts and with residents of communities bordering the port terminals who are concerned about traffic congestion. Additionally, environmental activists, perhaps the most visible and outspoken of all the stakeholders, are keenly interested in

any port activities that have the potential to upset the balance of the environment. Not appeasing them can result in negative publicity and time-consuming litigation over environmental issues. The drive toward deeper channels will only intensify the opposition efforts of some stakeholders who view the port's activities as a threat to the environment and their own self-interests.

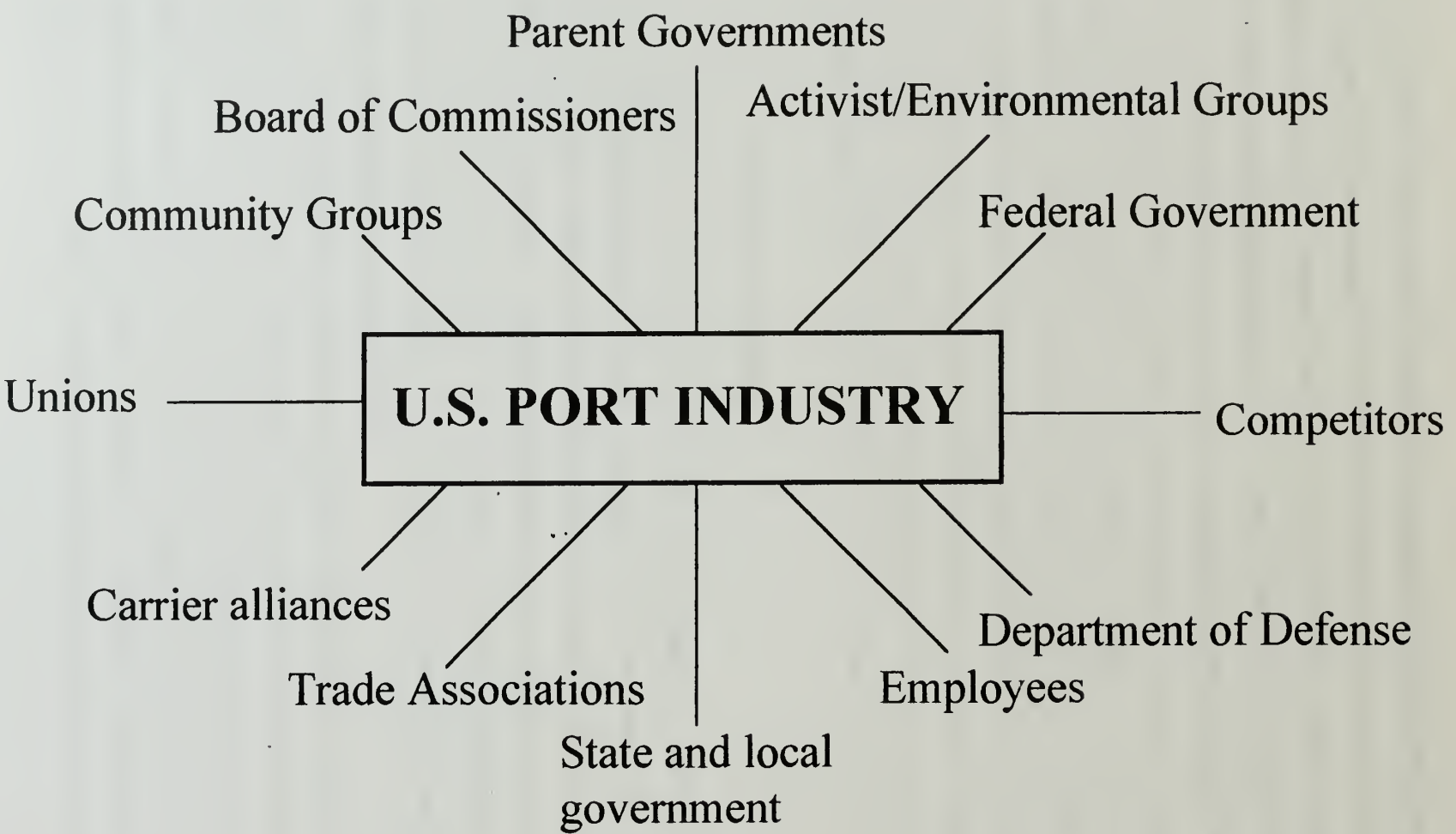


Figure 7. Stakeholder Map for U.S. Port Industry

Stakeholder opposition can not be overlooked since port authorities are public enterprises held accountable to act in the best interest of the public. Therefore, it will be incumbent on port officials to engage in dialogue with stakeholders, not only to explain the rationale behind port expansion, but also to help them understand the positive economic impact on their community.

3. Landside Access to U.S. Ports

Intermodal transportation is critical to U.S. ports and closely linked to our nation's economy, global competitiveness, and national security. Ports sit at the central point in the intermodal transportation chain [Ref. 22], serving as a transfer and collection point for approximately 95 percent of the commodities that enter the country. The efficiency of this intermodal connection could be threatened by increased bottlenecks in the adjoining transportation networks serving the ports. For some ports, the weakest link in the logistics network can be found at the back door, where congested roads or inadequate rail linkages connect to marine terminals. [Ref. 41:p.1]

A 1991 survey of U.S. port authorities conducted by AAPA found that 64 percent of container ports had their truck routes usually or always congested. [Ref. 41:p.1] With commerce expected to triple over the next couple of decades, it is unlikely that existing access routes will be able to accommodate the amount of truck traffic generated by the increase in freight movement without substantial increases in delays and costs. [Ref. 41:p.1] Pressure is mounting to address the landside access problems of increased traffic congestion, noise, and air pollution which spill over into adjacent municipalities. However, as long as container terminals do not have sufficient on-dock rail transfer systems and are required to dray (move containers by truck chassis) commodities to nearby rail transfer yards, traffic congestion along streets and access roads will persist.

Through no fault of the ports, urban areas have continued to be developed in the vicinity of terminal facilities, forcing maritime activities to compete with other

commercial, industrial, and residential developments for land and transportation accesses. Communities are now more aware of the environmental impacts of traffic growth. For example, air quality compliance program advocates have proposed restrictions on truck traffic during peak hours to reduce pollution and relieve congestion on nearby roads already crowded by commuters. These programs, no matter how beneficial to the environment, have serious implications for projects aimed at improving landside access. Conflicts between economic and environmental interests will only escalate as ports continue to expand in response to trade growth.

Some ports are served by state highway systems, either arterial or freeways, while others are only served by local streets and roads. Trucks share roadways with all other forms of vehicular traffic and are subject to peak period congestion in urban areas typical of port environments. [Ref. 40:p.9] The extent to which port-related activities contributes to congestion of given nearby accesses in surrounding urban areas can seriously impact the port's desire for outward expansion. Just as in the case of road side access, environmental tradeoffs may be necessary to increase the rail and truck traffic at ports. Train noise is another major concern, considering the close proximity of rail access routes to urbanized areas. Management of port growth with increasing urbanization, heightened environmental awareness, and limited financial resources all combine to create a significant challenge for U.S. ports.

Ports have attempted to reduce congestion along the nation's roadways by increasing their use of rail to transport commodities into and out of ports. Unfortunately, the usage of rail, double stack trains in particular, also contributes to landside access problems. Most commonly, the problems with congestion are accentuated by rail lines that intersect local streets at grade crossings. The problems are more prevalent at container ports than at other types of terminals because container ports tend to be located near urban areas. Seattle, Oakland, Chicago, and Wilmington (Delaware) are just a few cities that have experienced difficulties with rail lines crossing major streets at grade.

[Ref. 41:p.57] Longer trains and greater throughput at the ports will continue to cause problems of congestion and traffic conflicts in the future.

4. Waterside Access to U.S. Ports - Dredging

Accessibility to U.S. ports via harbor channels and connecting inland waterways is a critical issue. Waterside access routes not only must be monitored for safety reasons, they also must be dredged to ensure adequate channel depths are maintained. The issue of dredging and the disposal of dredged materials is more critical to port access than any of the individual land access issues. [Ref. 41:p.87] Most ports have multiple routes by which rail and trucking can access the port and terminal facilities. However, ships can usually only access ports via a single route through harbor channels and are heavily dependent on the ports ability to keep the entry route dredged. The introduction of larger containerships operated by carrier alliances only adds to the needs for deeper channels and pierside berths that can only be achieved through the time-consuming and costly dredging process.

The dredging process is characterized by its slowness and endless government hurdles. Permits are slow in forthcoming because of the existing laws and regulations relating to the disposal of contaminated sediment and the growing environmental awareness movement. For those ports that receive permission to dredge their harbors, the critical question is where will the necessary funds come from. Under U.S. law, the responsibilities for dredging comes under the regulation of two principal legislative authorities: section 104 of the Federal Water Pollution Control Act of 1972 (Clean Water Act) and sections 102 and 103 of the Marine Protection Research and Sanctuaries Act (MPRSA). Enforcement responsibility falls under the authority of two separate agencies, Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (COE), which overlap with regard to the issue of dredging disposal.

One of the primary goals of the U.S. transportation system is to facilitate the efficient and secure movement of people and cargo in a timely and safe manner. To do their part in accomplishing this goal, ports requires continuous maintenance and improvements to their channels and harbors. However, continued development and maintenance of U.S. ports has become a formidable task, particularly in the area of dredged material management. [Ref.14:p50] Naturally deep harbor channels are nonexistent in most U.S. ports; thus to accommodate modern vessels, dredging becomes an essential part of doing business. Currently, only three ports on the North America East Coast and five along the West Coast have main channel depths sufficient to receive vessels with drafts of 45 feet or more. [Ref.45]

According to an article published by Davis Helbrg, [Ref. 22:p.32] the current dredging dilemma facing many ports is nothing less than an crisis. The dredging crisis is driven by the question of when, how, and where to dispose of dredged "spoil." To comprehend the magnitude of the existing situation, consider that there are over 400 ports and 25,000 miles of navigation throughout the U.S. that must be maintained to keep waterborne traffic moving efficiently and safely. [Ref. 46:p.51] Annually, the U.S. Army Corps of Engineers (COE) dredges approximately 400 million cubic yards (mcy) – 300 million cubic yards from federally maintained channels and harbors. Permit applicants (e.g. , port authorities, terminal operators and other private industry) apply to the COE for an additional 100 million cubic yards of dredging annually from navigation projects (berths, access channels, etc.). [Ref. 46:p.51] Of the approximately 400 million cubic yards, about 60 million cubic yards are placed in ocean waters at more than 100 Environmental Protection Agency (EPA) approved sites. [Ref. 46:p.51] The remaining 340 million cubic yards are dredged in coastal and inland waters and placed in a variety of locations, including uplands, beach sites, wetlands and construction sites.

Because of the environmental impact of siltation and the removal of contaminated sediments from channel floors, it is necessary to monitor the dredging process and the disposal of dredged material. Dredging also disturbs marine life in the sediment to be

dredged, as well as the surrounding wetlands near harbors channels. As a result of growing environmental concerns, the application process for dredging can take anywhere from two to three years to satisfy the various regulations and stakeholder concerns. In one extreme case, the Port of Oakland, stakeholder concerns and government compliance resulted in a 20-year delay for a permit to deepen the channel leading to the port from 35 to 42 feet. [Ref. 41:p.95]

The complex environmental review process continues to slow the receipt of dredging approvals. As mentioned earlier, one reason for the slow process is the number of agencies and the involvement of special interest groups who participate in the authorization process. For example, several state and local agencies, such as the state departments of fish, game, and wildlife, the state and regional water quality control boards, and the state coastal-zone management programs [Ref. 41:p.95], share in the responsibility of dredging management. A typical example of the bureaucracy hurdles is the case of a major dredging project on the west coast. Negotiations relating to the dredging had to clear 63 separate offices of various regulatory agencies before approval was granted. [Ref. 41:p.95] Removing the multiple hurdles to the dredging application process is necessary if ports are to remain competitive and accommodate the larger vessels desiring to make port calls at their facilities.

C. OPPORTUNITIES FOR IMPROVEMENTS

The commercial port sector is actively engaged in developing new methods and practices aimed at improving productivity. Computerized operating and planning systems now used in the most advanced terminals will become widespread, and electronically transmitted documentation will become the norm. [Ref. 6:p.1] Among other innovations are the new MHE which is designed to support direct transfer of cargo from ships to the follow-on mode of transportation (internal or external to the port). In essence, the port industry is trying to establish an infrastructure that is more supportive of

the intermodal logistic network. One that is more efficient and productive in transferring the customer's commodities directly between the land mode and the ocean vessel.

1. Efficiencies in Productivity

The real issue for many ports is productivity - being able to improve upon existing practices and identify new cost-effective methods to meet the projected surge demands of the next-generation containerships. [Ref. 7] According to Rexford B. Sherman, AAPA, improving efficiency may rely on changing the existing labor practices. He refers to "cutting longshore labor costs (something that port authorities have no control direct control over) by extending working hours and even the work week, cutting gang sizes, and ending other guarantees of wage and employment." [Ref. 37] Efficiency in productivity pertains not only to labor-related activities, but also to innovations to advance better processing of cargo entering and departing from the port.

a. Labor

When you consider what alternatives are available to improve efficiency, one of the most obvious changes that requires no new technology to improve port productivity is operating 24 hours a day, seven days a week. [Ref. 6:p.5] Port productivity has to improve beyond its current level due to port competition and the demands of carriers for quick turnaround of their vessels. Currently, for most ports the workday does not extend beyond 8 to 10 hours. Therefore, operating around the clock is a logical means to improve productivity for all involved parties. For terminal operators, around-the-clock operation is a way to increase effective terminal capacity and smooth peak loads. [Ref. 6:p.5] For the customer, it offers greater speed of delivery and service. From a cost/benefit standpoint, operating longer hours is one of the only ways that ports can handle additional cargo without investing heavily in upgrading infrastructure. For carriers, idle ships sitting pierside means lost revenues--ships generate revenues at sea,

not in port waiting to be offloaded or loaded onto their decks. Table 10 gives an example of the projected cost ships incur during idle pierside time. The costs per day should be adjusted to reflect 1997 dollar values and the greater TEU capacity of larger containerships.

Table 10
Total system costs while one ship is in a U.S. Port

Cost Item	Cost per day ($US)
Containership (3000 TEU in port)	38,356
Containers	8,219
Cargo (est. 30,000 tons)	49,314
One port berth fully manned, gear included	27,397
Overhead, management, and miscellaneous	10,000
Total	136,268

[Ref. 16]

In 1986, a conference sponsored by the Marine Board of National Research Council and the Maritime Administration (MARAD) resulted in the following comments relating to labor at ports. "Although organized labor has not prevented the introduction of technological innovations at port terminals, the structure of labor-management relations in the industry has prevented terminal operators from realizing their full potential of containerization." [Ref. 38:p.153] Measures suggested to improve labor productivity included: the training of longshoremen in a variety of jobs, with appropriate financial rewards; encouraging continuous employment of the same longshoremen at the same terminal; and increasing training programs for first-level supervisors who deal directly with labor. [Ref. 38:p.153] Labor must also realize their

relationship in supporting terminal activities by becoming more flexible and better prepared to adapt to the changing landscape of the port

b. Material Handling Equipment and Operating Procedures

Carriers hold terminal operators responsible for providing quick and safe methods for transferring cargo from ships to the various modes of transportation (e.g., rail, truck) for temporary stowage or further transit in the intermodal network. Because of the increasing size of ships (width and height) and carrying capacity, many ports are concluding that existing material handling equipment (MHE) must be replaced and that existing handling procedures need to reevaluated. Based on the research of this thesis, there appears to be a consensus that the industry is moving toward MHE and concepts that support direct transfer of cargo from ships to the follow-on mode of transportation (internal or external to the port).

Various MHE techniques, either available for use or under development, have the potential of increasing productivity when employed by terminals.

1. Continuous Flow Rigs. These are systems that receive the container directly from the crane, a conveyor monorail system, or a mechanical "merry-go-round." [Ref. 6:p.6] This particular type of crane arrangement (Figure 8) allows for uninterrupted handling of containers and has appeal because it has the potential to work next-generation containerships without major adjustments or design changes.

2. Automated Guided Vehicle System (AGVs). AGV technology is being considered for many applications within the current port infrastructure. "Mini trains," or small automated trains, are just one example of the potential benefits of this technology. Mini trains are AGVs which are capable of moving multiple container loads around the terminal yard to either a temporary storage destination or an off-terminal site. An

alternative system using automation is currently being developed by the ECT Corporation. [Ref. 6:p.6] This system uses existing dual-trolley, high speed wharf cranes, which are served by a fleet of AGVs - unmanned straddle carriers. At the storage areas, the containers are moved and stacked by oversized gantry cranes that are also unmanned. AGVs are not limited to internal port use; they also can be integrated into off-terminal intermodal facilities to relieve traffic congestion problems.

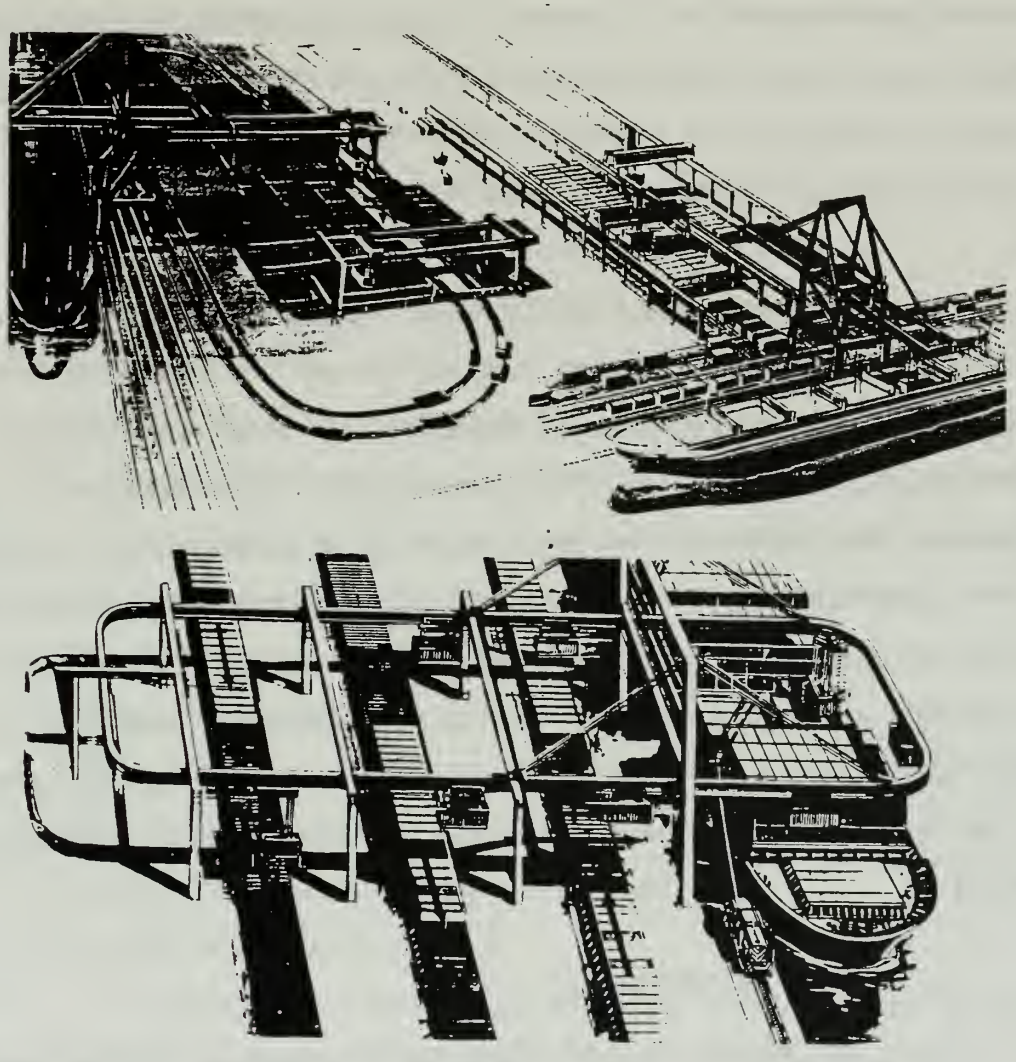


Figure 8. Merry-go-round crane for uninterrupted handling of containers. [Ref. 16]

3. On-dock and Near-dock railyards. On-dock rail is rapidly gaining status as an important competitive advantage for many ports. The concept is simple: direct ship-to-rail or rail-to-ship transfer when loading or unloading containers, eliminating the need for expensive drayage of cargo to nearby rail or storage yards. [Ref. 35:p.29] For many ports, on-dock rail is essential because it is one of the quickest methods - and sometimes the only method - that can handle large volumes of cargo efficiently. On-dock rail also helps to alleviate port congestion and pollution caused by trucks transiting urban areas. Another alternative, more sensitive to space and flexibility needs of dockside terminals, is to construct large intermodal railyards near the port area, minimizing the length of drayage, which ideally would be funneled onto specialized roadways between port and railyards (such as an intermodal container transfer facility (ICTF)), insulated from public traffic. [Ref. 28:p.136]

4. Simultaneous Load and Discharge (SL&D). Using computer simulation, Vickerman-Zachary-Miller, Maritime Planning, proved that existing on-dock facility layouts can dramatically increase the throughput by improving operations without expanding port property. [Ref. 49:p.97] By applying the "just-in-time" inventory practice of minimal storage and faster transfer of cargo between modes, the study examined the effects of simultaneous load and discharge (SL&D) as an operational efficiency. SL&D involves the simultaneous loading of import containers onto trains and export containers onto the ship, as long as the ship and train begin operations at the same time. If the rate of unloading the ship is matched by the SL&D of the train, transferring ship inventory to the train could be accomplished with no buildup of import containers from the ship. [Ref. 49:p.97]

c. Gate Processing

The interface between the port and the intermodal logistics network for many customers begins at the terminal's access point. Gate access at many intermodal

facilities is often the weak link in the chain of operation. [Ref. 49:p.88] Most bottlenecks (traffic congestion points) occur at terminal gates and are increasing as the volume of corresponding traffic increases. Truck queues not only block city streets in surrounding communities, but they also create unsafe conditions and interrupt yard operations.

Gate procedures can be improved through reengineering the process of an intermodal yard, based on the needs of the carrier, shipper, and yard operator. [Ref. 49:p95] By removing long-standing norms of operation (human interaction with entry procedures) and replacing them with new techniques that improve process time, gate throughput can increase. The article, *Intermodal Rail Facility Design for the Next Century*, suggests that the following changes could be implemented to improve process times and reduce inbound and outbound queue lengths.

1. Inbound empty and bare chassis lanes;
2. Bobtail (road tractor) lanes requiring only precheck;
3. High, wide and heavy lanes that may bypass check-in area;
4. Spots for trouble parking; and
5. Minimized inspection procedures that statistically monitor damages by inspecting less than 5 percent on in gate moves.

The following technological improvements can reduce process time as well as inbound and outbound queue lengths:

1. Video ID cameras;
2. Precheck area printers;
3. Speaker pedestals;
4. Swipe ID cards for drivers;
5. Automatic Equipment Identification (AEI); and
6. Electronic Data Interchange (EDI).

An optimal gate process would help improve throughput at the nation's ports and would give military units deploying through ports easier accessibility to the ports terminals and berths. Ideally, the most efficient terminal is one that is capable of

integrating the various processes and technologies to increase productivity and improve gate access. Figure 9 represents a typical intermodal gate arrangement of a state-of-the-art rail facility.

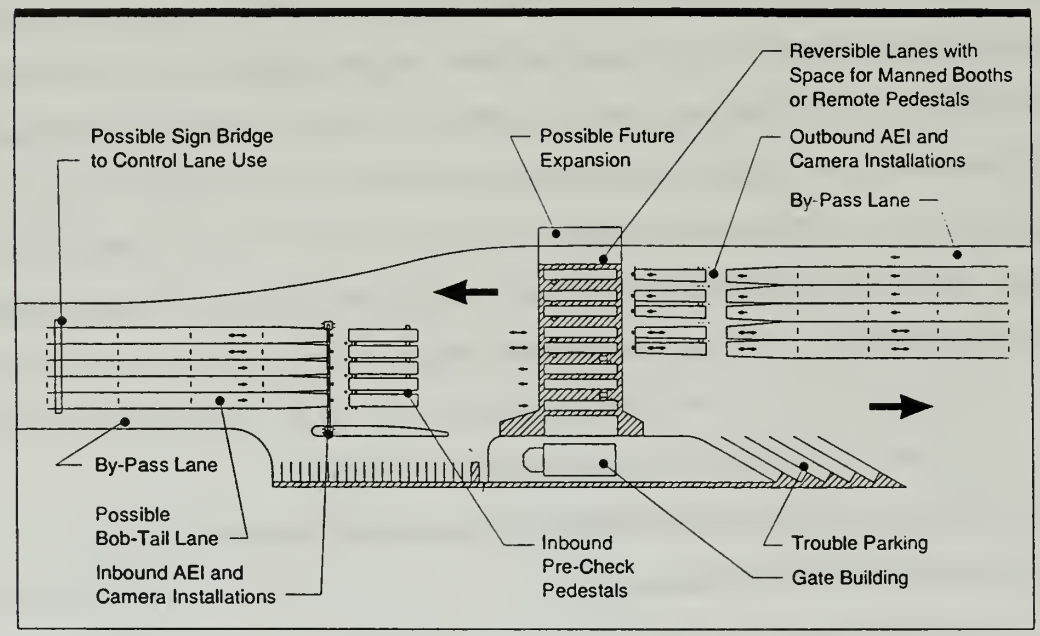


Figure 9. State-of-the-art rail facility gate. [Ref. 49]

2. Landside Access to U.S. Ports

The opportunities available to improve landside access to U.S. ports are challenging because improvement efforts are costly, and residents along access routes must be lobbied for their support. Much like the issues associated with dredging, landside access also has received national attention. Most recently, the Federal Highway Administration (FWA) has sponsored a series of regional conferences to examine the impact of ship design on transportation and operations. The conferences have brought together various transportation-related entities (such as carriers, trade associations, and third parties), as well as state and local governments, to address the issues associated with

congestion of accesses leading into the ports. One area of discussion is the implications of increased port activity (tonnage) on the nation's highways and roads.

Independently, ports are already pursuing a number of strategies for resolving their access problems:

1. Dedicated freight corridors between terminals and major rail and highway connections;
2. More use of on- or near-terminal rail service ;
3. Greater reliance on barge or intercoastal vessel shipments, which could reduce traffic between some maritime terminals and other coastal cities. [Ref. 41:p.13]

The most promising of the strategies is the utilization of rail-truck corridors, which have become popular in recent years. Traffic congestion caused by trucks and passenger vehicles traveling along the same routes could be greatly reduced by building facilities (both highway and rail) dedicated to freight movements. Corridors are expensive, as witnessed by the growing price tag of the Alameda corridor in Los Angeles. The corridor's initial $500 million cost has more than tripled as expenses have escalated for offsetting adverse effects in the surrounding communities. [Ref. 41:p.60] Yet, despite the negative aspects, corridors are a worthwhile alternative for meeting the needs for establishing off-terminal facilities and improving long-term congestion problems.

3. Dredging and Environmental Issues

The problems associated with dredging can influence the U.S. economy, defense efforts and environment. President Clinton, on August 13, 1993, acknowledged that the process of dredging and maintaining the nation's ports sometimes does not work as well as it could. [Ref. 46:p.52] The President wrote, "Too often, dredging projects are caught up in regulatory tangle," and he noted, "Ports can only realize their full potential as magnets for shipping and commerce if our nation's harbors are dredged and open for

trade." [Ref. 22:p.32] White House attention has resulted in the formation of an Interagency Working Group to investigate and recommend actions to improve the dredging project review process.

As a result of the Interagency Group, several spin-off groups have been established to provide guidance and assistance on national and regional levels in the development of long-term dredged material management plans for the nation's ports. The actions initiated by the Clinton administration may fall short of a call for a national dredging policy, but they been partially successful in bringing the issue into the forefront of discussion. The September 1996 Congressional approval of the Water Resources Development Act (WRDA) of 1996 was also a critical step which will allow ports to meet the growing demands of world trade. According to Kurt J. Nagle, President of the AAPA, "WRDA is essential for ports and the businesses that rely on the transportation services they provide."

WRDA legislation, among other things, authorizes deepening and modification of federal navigation projects at the nation's ports. WRDA '96 provides for policy changes which will enable the COE to perform their functions of dredge management and navigation mission more efficiently. It includes provisions long supported by the port community that authorize equitable federal cost-sharing of dredged material disposal facilities, provide for prompt removal of obstructions to navigation, and caps the local cost-sharing during the feasibility stage of project development. [Ref. 28]

D. CONCLUSION

If ocean carriers continue their operational practices of deploying larger containerships in global shipping alliances, ports that are unprepared will struggle to maintain productivity. Ports must develop long-term strategies to meet the demands for expansion and to increase productivity by pursuing ways to offset the impediments to operational effectiveness. However, because of the complexity of the impediments, without federal intervention through policy changes in existing regulations or

involvement as mediator among the various stakeholders, the obstacles to success will persist for most ports.

Many ports have used the opportunities afforded by technology to move past the government bureaucracy and stakeholder pressure to become more efficient. Their individual accomplishments should serves as benchmarks for other ports. As mentioned earlier in this chapter, efficiencies can be achieved by refocusing the labor force in a direction that is more supportive of the ports' objectives and through the utilization of technology. Technology has the greatest potential to improve the level of service the ports can deliver. Figures 10 and 11 compare the values of specific terminal design elements that can greatly improve cargo flow on a systems level using the various sources of technology to promote throughput.

In the final analysis, resolving the pending problems must involve constructive dialogue with stakeholders, becoming more attuned to the environmental concerns of the public, utilizing technology effectively, and improving labor relations.

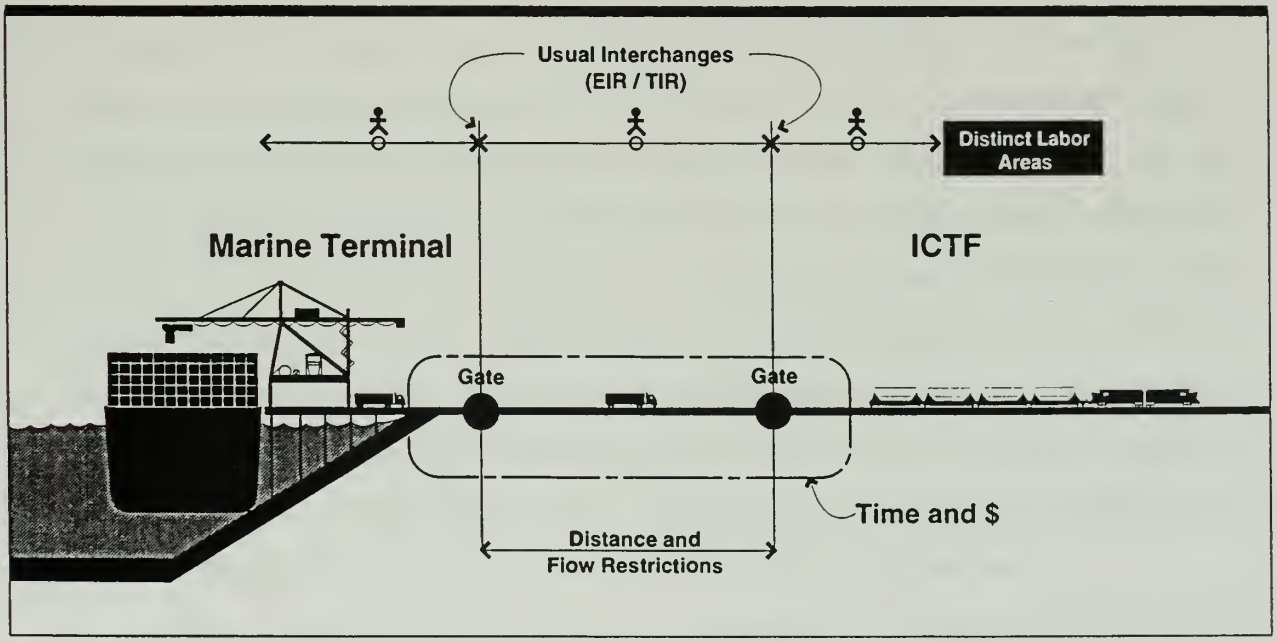


Figure 10. The intermodal interface, "the way it is." [Ref. 49]

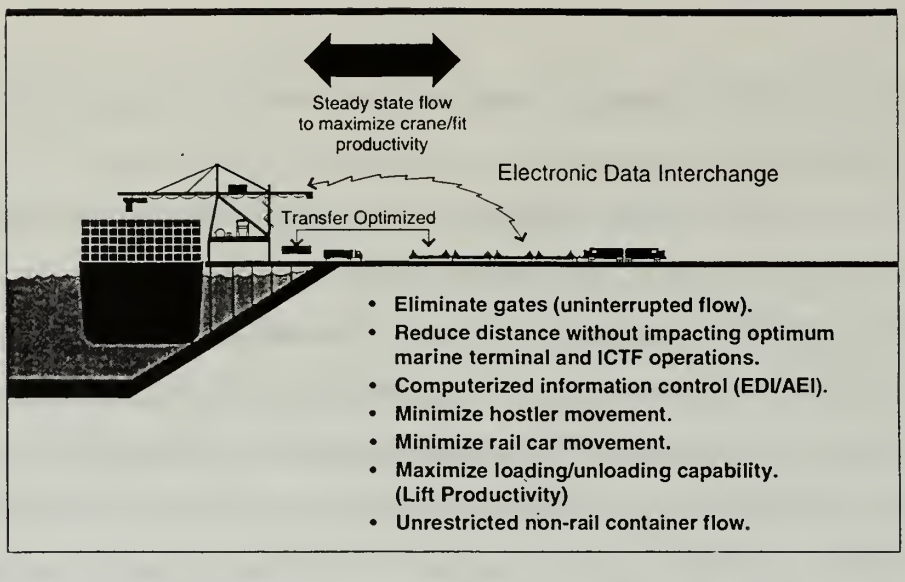


Figure 11. The intermodal interface, "the way it could be." [Ref. 49]

V. MILITARY OPERATIONS AT U.S. PORTS

A. INTRODUCTION

The dissolution of the Warsaw Pact, the reunification of Germany, and the revolutionary changes in the former Soviet Union substantially diminished the importance of keeping American forces and equipment forward-deployed to protect the national interest of the United States abroad. Equally important is the influence of political reorganization in Eastern Europe and the former Soviet Union over the framework used in mobility planning. For many contingency scenarios, military planners can no longer rely on overseas units with their own equipment and supplies to respond quickly to the perceived threat. Instead, they must rely on the rapid deployment of U.S. forces and equipment from in CONUS installations.

Since the fall of the Berlin Wall, the U.S. Army has deactivated three combat divisions, a war fighting corps, and more than 341 nondivisional units. [Ref. 9:p.7] In addition to the troop withdrawals, the U.S. has also returned or redistributed thousands of military vehicles and thousands of tons of supplies and ammunition to the U.S. The U.S. has also reduced the number of overseas warehouses from an cold-war era high of 19 to a post-cold-war five. [Ref. 9:p.7] Because of these drawdowns, the nation has placed greater emphasis on a new global strategy of rapid deployment from CONUS to compensate for the withdrawal of forces and equipment from Europe. No longer will the U.S. adhere to the philosophy of maintaining thousands of troops overseas in support of national interests. Instead, there will be a greater reliance on the rapid deployment of CONUS-based troops and equipment to support contingency requirements.

In this context, the U.S. port industry now assumes an even more strategic role in national defense: to facilitate efficient and effective unit throughput at their terminals and facilities. Ports (and the supporting intermodal network) can no longer be thought of as merely an exchange point for military cargo and equipment traveling overseas. The new

philosophy of rapid deployment from CONUS requires that ports be integrated as an essential element of mobilization. Failure to include ports in mobilization planning phases and preparedness exercises will ultimately result in inadequate accessibility, berths and yard space for military deployments. Therefore, military planners must make every attempt to familiarize themselves with the conditions that impact the port's capabilities because these very conditions may either impede or improve military interaction with the port.

This chapter will examine the U.S. port's role in supporting military mobilization efforts. It will also focus on the potential implications for military port usage as a result of the factors affecting U.S. ports (discussed in chapter IV). Lastly, this chapter will highlight the technology and automation opportunities available or under design that can improve the utility of port operations in support of military deployments.

B. MILITARY MOBILIZATION REQUIREMENTS

1. Overview of Military Operations at U.S. Ports

Military units deploying through ports, unlike commercial port customers, have some unique requirements linked to military readiness. During the course of the Desert Shield/Storm buildup of 1990-1991, for example, more than four million tons of cargo were shipped through U.S. ports [Ref. 41:p.109] to meet the initial surge and sustainment requirements. Even though the aggregate cargo estimates may pale in comparison with a commercial intermodal system that handled approximately 2.7 million TEUs of containers and trailers in the first weeks of 1996, [Ref. 9:p.9] the military's unique operational and cargo handling requirements could have challenged the productivity capabilities of many ports. For instance, during the Desert Shield/Storm buildup, the port authority, as facility owner, was tasked with providing the military with administrative facilities, staging and storage areas, rail and truck unloading points, back-up-security, and, in short, ensuring that facilities and services required by its military customers were readily available. [Ref. 9:p.11]

In some instances, military deployment requires immediate accessibility and availability to the nation's ports for sustained periods to expedite the movement of troops, supplies, and equipment in response to national security demands. Deploying military units requires considerable amounts of yard space to carry out the functions of terminal reception processing, stuffing of containers, and other related activities, before equipment can be transferred aboard ship. Additionally, military interaction with the ports presents challenges for port and terminal managers who are catering not only to the military, but also commercial customers, who desire the same level of service and terminal space as they do when there is no military deployment.

In most instances, deploying military units arrive at ports via several different transportation modes, rail being the preferred method because it keeps transportation costs minimal, while reducing damage and inefficiency. Other pieces of equipment and vehicles can arrive via trucks, the inland waterway system, motor convoys, or even can be airlifted to the port. Once the equipment arrives, it must be staged in areas referred to as marshaling yards. In some ways, marshaling yards are similar in purpose to container yards used by ocean carriers in that they provide temporary in-transit storage. However, the military also uses these areas for selective, controlled and flexible phasing of container or cargo movements to destination or vessel. [Ref. 27:p.III-8] Different than commercial container yard space, the marshaling yards also provide an area for cargo/container maintenance, repair, servicing, and inspection; stuffing and stripping; documentation; cleaning and decontamination; and security. [Ref. 27:p.III-8] Following processing and handling, the equipment is ready for transfer into the port's vessel loading system. The organization of traffic flow through a fixed-port container transfer facility is shown in Figure 12.

Figure 12. Organization of and traffic flow through a fixed-port container transfer facility. [Ref. 27]

2. Authorization Framework for Port Usage

The Department of Defense (DoD) makes extensive use of commercial shipping and port capacity in peacetime. For immediate response to a national emergency, deployment of military forces requires additional capacity and services. Even though the commercial port sector is capable of meeting most military demands, the duration and volume of traffic during mobilization efforts can disrupt a port's normal activities. Recall that port authorities are public enterprises that exist not only to provide a service to its customers; they also must be profitable whenever operationally possible. Therefore, to minimize the disruption of commercial activities, peacetime planning must coordinate the needs of port management, other port stakeholders and the military. Prior planning, through working groups, committees, and preparedness exercises, enables entities to identify operational problems, devise new ways to deal with them, and reconcile potential conflicts before an emergency develops.

If dialogue fails to give the military sufficient priority over port usage, the DoD can institute measures available to guarantee usage. If the situation justifies it, DoD may execute its rights to full and autonomous control of the nation's ports in the interest of national security. However, taking control of a public port that serves a predominantly commercial clientele is hard to justify from economical and political standpoints. In order to achieve an acceptable balance between military and commercial demands for port resources, certain programs and legislative statutes are in place.

a. Federal Port Controller Program

A declaration of war or other national defense emergency may require DoD to make sure military units receive the highest priority of service at ports. In an attempt to keep military disturbances at ports to a minimum, the Federal Port Controller Program establishes contractual arrangements between MARAD and local firms or agencies – typically, but not necessarily, a port authority. [Ref. 36:p.13] Federal Port

Controllers (FPCs) are appointed under the terms of the contract not as commanders, but rather as controllers of the movement of essential civilian and military cargoes through commercial ports when priorities and allocation authorities are used.

FPCs, when tasked, become the local agents for MARAD, reconciling conflicts in port emergency requirements between defense agencies and commercial entities. The government agency responsible for the FPC program is the Office of Ports and Intermodal Development (OPID) of MARAD. In coordination with some DoD agencies, OPID has compiled a list of U.S. ports that are projected to handle both military surge and sustainment cargoes, and civilian cargo during a war or national defense emergency. [Ref. 23:p.13] The ports identified in the listing are invited to participate in the FPC program because of their geographical proximity to military installations and other operational capabilities deemed beneficial to national defense. As of January 1992, OPID had FPC contracts with 52 ports. Although no FPC contracts were activated during Desert Shield/Storm, the training provided under MARAD's FPC program certainly contributed to the success of the operation. [Ref. 36:p.14]

b. Legislative Authority

Title 46 of the Federal Code of Regulations (FCR) Part 340 includes procedures to be used by defense agencies and the Department of Transportation to obtain port facilities for the deployment of U.S. military forces or other requirements of national defense. To provide priority for defense cargo movements before the outbreak of hostilities and in wartime, without seizure of port facilities by a military service, the National Shipping Authority (NSA) is prepared to apply the priority and allocation authority granted to the President by Title I of the Defense Production Act. [Ref. 44:p.18] Under this regulation, MARAD acting as the NSA may require port operators to provide defense agencies with commercial services and facilities that cannot be provided through regular acquisition procedures.

MARAD's goal is not to seize the property of port owners in the interest of national defense, but to ensure that the rapid deployment of military units has a high priority and is conducive to normal port operations. The Military Traffic Management Command (MTMC), in its peacetime planning, identifies ports likely to be used for deployment of forces under Joint Chiefs of Staff and Unified Command operational plans and reaches informal understandings with port authorities on the berths and facilities needed. [Ref. 44:p.18] MTMC submits its perspective list of suitable ports to MARAD, which in turn, issues port planning orders (PPOs) that confirm the understanding between the port and MTMC.

PPOs are MARAD's notifications to the commercial ports defining tentative agreements to meet anticipated defense agency requirements for port facilities and services. The PPO for the Port of San Diego, for example, clearly specifies priority use of National City Marine Terminal, berths 24-2, 24-3, and 24-4 with associated staging areas. Planning orders are for planning purposes only and carry no enforcement power. Figure 13 shows the current list of strategic ports where PPOs are in effect. The dates listed under the names of commercial strategic seaports indicate the expiration dates of the PPOs.

During conditions necessitating a deployment of forces, MTMC may request priority use or allocation of port facilities and services identified in the PPO. If, for some reason, MTMC and the port of choice cannot agree on a plan that will allow for military priority use in a timely manner, then MTMC can submit a request to MARAD specifying the kinds of services and facilities required at each strategic commercial port, the approximate scale of operation, and the justification for priority use of port facilities and services. The Administrator of MARAD determines if the actions are necessary, and if the proposed approach is the most effective way to meet the requirements of the deploying units. Before issuing an order, the Administrator will evaluate the extent to which his or her decision will impact the disruption of commercial activity at the port.

Under the terms of 46 CFR Part 340, there are two types of NSA orders: NSA Service Priority Orders (NSPO) and NSA Allocation Orders (NAO):

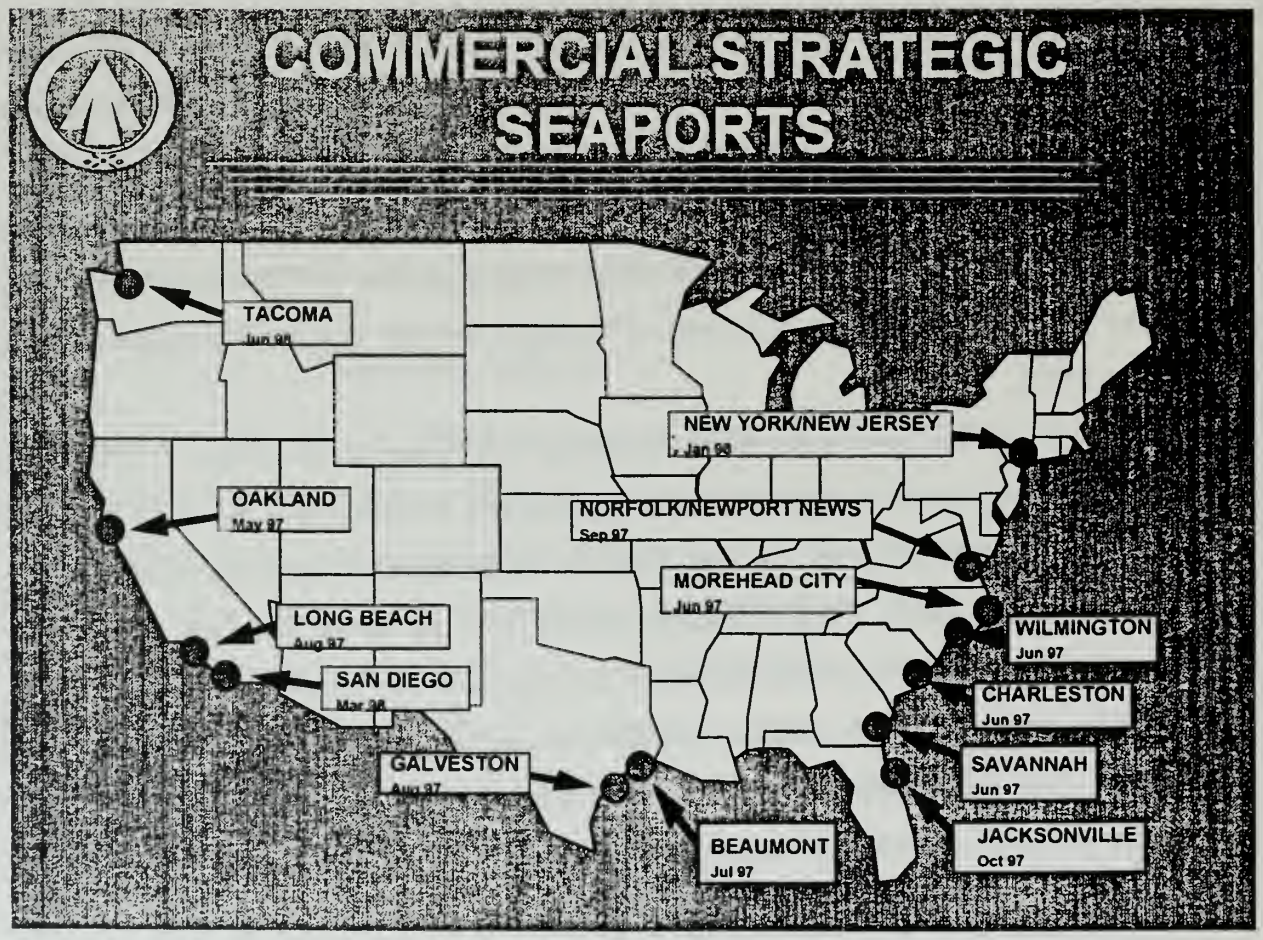


Figure 13. Commercial Strategic Seaports (Provided by MTMC)

1. National Shipping Authority Priority Orders (NSPO). When a national emergency is declared, the NSPO is used to obtain "priority" use of a facility or services for a particular event, mobilization, or rapid movement of "surge" cargoes in the first stages of the event. [Ref. 44:p.19] Service orders are used primarily for operations of short duration.

2. National Shipping Authority Orders (NAO). An allocation order is used to obtain exclusive use of services or facilities on a continuing basis. NAOs are most commonly used when a service or port facility is required to meet unit replenishment needs for a dedicated purpose or for a protracted period. [Ref. 44:p.19]

3. Memorandum of Understanding on Port Readiness

The responsibility of managing the throughput effectiveness of military units cannot rest solely on MARAD and MTMC. Seven federal agencies and organizations – MARAD, the U.S. Army Corps of Engineers (COE), MTMC, Military Sealift Command (MSC), the U.S. Coast Guard, the Naval Control of Shipping Organization, and the Maritime Defense Zone - have joint responsibilities for the movement of military forces and equipment through U.S. ports. [Ref. 44:p.21] In 1984, six of the organizations signed (the Maritime Defense Zone did not sign until 1991) a memorandum of understanding (MOU) on coordination and cooperation to ensure readiness to support force deployment in national defense emergencies. The MOU outlines the areas of jurisdiction of each agency and provides for timely exchange of information among the agencies to meet the specific planning needs for military deployments.

In order to implement the group's work, the MOU established a steering group (National Port Readiness Steering Group [NPRSG]) and a working group (National Port Readiness Working Group [NPRWG]). The NPRSG determines policy and directions for meeting objectives, and the PRWG implements these policies and priorities. At each strategic port, representatives from the seven agencies come together to establish a Port

Readiness Committee (PRC), which coordinates peacetime preparations and port operations in emergencies.

Port Readiness Committees allow the different agencies and members of the local port community to address the issues and develop strategies for improving military throughput. For example, the 1997 Northern California PRC port readiness exercise provided an excellent forum for addressing issues that could impact a military deployment through the Port of Oakland. Results of Port Readiness Committee workshops are forwarded up the chain of command for review and consideration in planning port mobilization efforts.

C. POTENTIAL IMPLICATIONS FOR MILITARY PORT USAGE

The efficient military usage of U.S. ports is inevitably linked to the port industry's ability to address the impediments to effectiveness discussed in Chapter IV of this thesis. In most cases, the DoD's concerns, with a few isolated exceptions, are similar to those expressed by the ports' commercial customers. Both desire a port infrastructure that provides an acceptable level of service, quick turnaround for their vessels and efficient throughput. The DoD is not immune to the problems currently facing the port industry. In fact, the military may be more susceptible to these problems because of the need to rapidly deploy equipment and vehicles overseas. Indeed, any problems that affect the port industry's commercial business will eventually affect DoD. Military units, in most instances utilize the same access roads, facilities and MHE as their civilian counterparts and are therefore subject to the same problems.

This section will examine some of the issues that may impact military throughput at U.S. ports in the upcoming years. The section will not discuss those problems addressed in Chapter IV that are also relevant to the military.

1. Port Accessibility

Military units arrive at seaports of embarkation (SPOE) via the various modes of land, air and water transportation alluded to earlier. Having free and unimpeded access into SPOEs is the first step to ensuring successful military deployment. Since seaports play an important role in national defense, the existence of landside impediments to ports affect not only transportation efficiency, but also other aspects of military readiness. Ideally, military units would like to traverse along dedicated thoroughfares and have independent entry gates to expedite access into departure ports. This may be one method of improving port accessibility, however DoD is not the sole customer for most ports. Lucrative commercial interests must be considered in the balance between commercial and military activities.

Using Desert Shield/Storm as a frame of reference, few ports reported bottlenecks. According to an AAPA port survey of approximately 18 ports involved in Desert Shield/Storm, the buildup went fairly smoothly in most respects. [Ref. 41:p.109] However, it must be taken into account that the buildup occurred over a period of seven months and during a period in which port-related business was slack. In a crisis requiring a faster and/or larger mobilization, more commercial traffic may be disrupted with more extensive bottlenecks. [Ref. 41:p.109] The current port environment has changed in some ways from the Desert Shield/Storm era. The maritime industry is expanding in anticipation of an expected doubling trade growth (imports and exports), which will undoubtedly impinge on accessibility for military units in upcoming years.

Aside from problems related to landside access issues, port accessibility for military deployments, can also be influenced by a number of other factors. The unsequenced arrival of large deliveries of trucks and rail cars can lead to unforeseen port congestion. Ships not arriving as scheduled, or delayed in departure because of poor handling or maintenance issues, can leave hundreds of containers and pieces of equipment stranded in queues waiting to be processed. Port accessibility problems will

always exist to some extent because so many entities - railroads, trucks, and property owners impact the process. The key is moving commodities efficiently through ports through effective planning of routes and adhering to prearranged schedules.

2. Port Availability

Port availability has been the subject of much debate in recent years, ever since carriers announced the introduction of next-generation containerships and their intentions to deploy them in ports designated as load centers. The continued availability of berth space and facilities that meet the standards and requirements of DoD is still in question. Ports are understandably concerned that, in this era of increased internal competition, any additional requirements that could disrupt commercial activities be monitored carefully. The increase in commercial traffic and fierce competition has put a lot of stress on the ports, according to Major L. Idell, MTMCHQ. She points out that ports which are capable of meeting the needs of the private sector are also the preferred choice of the military. [Ref. 25] Therefore, if the military causes any disruptions in commercial services, the port loses business and may incur a penalty for not meeting delivery or pickup requirements.

Despite being compensated for their losses as prescribed in Title 46 CFR Part 340, a few ports have requested to be undesignated as strategic ports of embarkation. Their requests are based largely on concerns about space requirements and fulfilling commitments to commercial customers. The research for this thesis, suggests that this trend will continue unless government transportation officials are able to strike a balance between military and commercial activity that satisfies the ports. As stated throughout this thesis, the port industry has invested considerably in infrastructure improvements, hoping to capitalize on the projected growth in trade. Any port-related activities that could jeopardize their return on investment will be viewed as a potential obstacle to their efforts to become self-sufficient.

Ms. Liburdi, Director of the Port Department of the Port Authority of New York and New Jersey, described the port availability situation on the eastern seaboard this way: "[Commercial] ports will work with the military, but we need time. That does not mean ports wouldn't be available in emergencies, but that with the increase in commercial operations in recent years, they can not unilaterally accept military cargo, or the disruption a deployment would cause their business [to be harmed]." [Ref. 50:p.9] The Port of Houston, for example, refuses to participate as a strategic port. Others ports, such as Charleston, have placed limits on availability and facilities the government may lease on short-term notice. [Ref. 50:p.9] The Port of Galveston has requested that MTMC try to find another port to accommodate the demands of the military.

3. Disruption of Commercial Activities

When military mobilization impacts the commercial activity of the port, the disruption not only results in lost profits and productivity. It also upsets the entire flow of commodities moving throughout the intermodal network. In August 1996, MARAD sponsored a study, the Response Model to Disruption of Maritime Transportation Systems [Ref. 43] to analyze the impact of military operations on the disruption of marine terminal capacity and throughput. The study conducted under the direction of the Louisiana State University(LSU) National Ports and Waterways Institute (NPWI), was tasked to develop a tactical and operational response model (RM) to analyze and evaluate the impact. The investigation focused on measurers of container terminal capacity and throughput at the berth level by concentrating on deterministic flows of vessels and containers for berths, storage yards, and truck access lanes (gates). This subsection will summarize pertinent findings of the final report issued upon conclusion of the study.

Briefly, the RM used a variety of data as input variables (e.g., yard storage capacity and utilization) from ports identified by MARAD to participate in the study. The basic inputs of the RM consisted of three elements: configuration, sailing schedule,

and mobilization units. MARAD provided the hypothetical mobilization scenarios for the six ports involved in the study: Savannah, Jacksonville, Charleston, Oakland, Beaumont and Tacoma. The output of the model identified the units of berth, yard and gate infrastructure removed from commercial service each day according to the mobilization scenario. Output also reflected the estimated costs of disruption for each element by applying a disruption factor, expressed as dollars per event to the number of units applied.

The results of the analysis indicated that marine terminal capacity and throughput exhibit substantial cycles of different rates of intensity use, ranging from nearly full to empty, to cycles with more steady levels of occupancy. [Ref. 43:p.42] Furthermore, some ports appear to have sufficient capacity to accommodate hypothetical emergency mobilizations throughout current throughput cycles. Then there are ports and facilities where mobilization does not appear practical without substantial changes and/or outright disruption of existing commercial services. [Ref. 43:p.42] Operations changes in this context refer to varying operating hours, adjusting sailing schedules, or manipulating other variables which could increase container throughput.

The study also concluded the most variable component of terminal capacity is yard space. Ports with relatively large yard areas that could easily accommodate hypothetical mobilizations with minimal changes in yard storage include Norfolk, Savannah, Jacksonville, Beaumont and some facilities in Oakland. [Ref. 43:p.42] Other ports which appear to have higher yard space occupancy levels reflect combinations of infrequent sailings, extensive chassis parking, low density stacking and relatively long container dwell times. [Ref. 43:p.42] Changes in these variables for those particular facilities would impact their commercial operations. Lastly, one important point from the study indicates that if military mobilization requirements were reduced from a maximum of three to two berths, more terminals could be considered as likely candidates for military usage.

This study is important for military planners because it uncovers certain variables that must be examined before selecting a port for mobilization. It also shows that many ports and facilities are affected by several factors (ship sailings and container dwell) which if not addressed, will disrupt commercial activity. Although many of the identified variables which could impact military mobilization efforts are beyond the control of the military. If these factors are accounted for in planning phases they can minimized and the affect of military mobilization lessened.

D. OPPORTUNITIES FOR IMPROVEMENTS

Each year the commercial transportation sector invests $millions in new equipment and technology to enhance its systems to become more competitive and to reduce overall operating costs. These transportation advantages can also be put to use by DoD. With recent changes in the national defense strategy, the ability to rapidly deploy forces overseas using available commercial resources is now much more important. The benefits for the military that can derived from containerization and intermodal transportation are the same as the commercial sector: lower costs, decreased transit times, and lower rates for damage. [Ref. 46:p.68]

For military and government transportation planners, the opportunity to take full advantage of the commercial transportation system is an opportunity to gain a strategic advantage. MARAD in its role as national promoter for the nation's ports, has increased coordination efforts with the commercial sector to explore ways that existing systems can be used for military purposes. There are two programs currently in place to facilitate this exchange of information. TRANSCOM's Center for the Commercial Deployment of Transportation reviews existing and emerging technologies that may be of some benefit to the military. Second, the Cargo Handling Cooperative Program operated by commercial companies assists member companies in exploring ways to increase productivity and enhance competitiveness.

The remainder of the section will examine some of the existing opportunities under development which may benefit military throughput and improve efficiency.

1. Landside Access

The Desert Shield/Storm buildup received favorably comments by many port officials because of earlier planning efforts. The preexistence of port planning groups convened to organize military port use helped resolve issues quickly without causing delay, this according to Sherman, AAPA. [Ref. 36] DoT and DoD have planned extensively for military use of the U.S. surface transportation system. The two agencies have jointly identified defense highway needs, which consist of the 59,800 mile Strategic Highway Corridor Network (STRAHNET) and some 6,000 miles of connector routes extending between the STRAHNET and important defense installations. [Ref. 41:p.112] The routes identified are essential to military transits since the routes provide easy access to defense installations, and overhead (bridge) clearances are sufficient for passage. A subset of rail lines important for national defense and security has also been identified known as STRACNET. This rail network covers 38,000 miles of strategic rail lines and 5,000 miles of connector lines to military installations. [Ref. 41:p.113]

2. User-friendly Marine Terminals

Ralph Compton, [Ref. 9:p.7] describes the ideal intermodal marine terminal as facility that will be user-friendly when supporting military deployments. Using a hypothetical deployment of Army forces, Compton simulated the processes to adequately support DoD deployment objectives. His concept is composed of three necessary transportation subsystems: reception and terminal handling, staging, and vessel loading. The terminal's capability to receive and process military cargo is the first subsystem discussed.

There would be a separate gate for arriving convoys to enter the terminal. [Ref. 9:p.9] The gate would be located out of the vicinity of normal access routes to allow for unimpeded entry to the port and not to disrupt inbound/outbound commercial traffic. In terms of handling, the terminal should be capable of receiving and unloading about 200 to as many as 400 flat rail cars. [Ref. 9:p.10] The terminal should also be able to support an sufficient number of rail spurs with end ramps for "circus style" unloading of military wheeled and tracked vehicles. Compton also makes an assumption that the port must operate 20 hour work days to meet the demands of the rail movement.

The next step in the process is the staging of vehicles following the reception process. The ideal staging area will include sufficient space to safely store and work around the cargo as well as offer other work areas needed to support the operation. [Ref. 9:10] Segregation according to Compton, is critical to safe, secure, and efficient reception and handling of DoD's sensitive and hazardous cargoes. This requires a separate dedicated marshaling area to support this step in the deployment process. The formula for determining the amount of stage required is:

$$(CA \times S/A) + (CA \times SV) + (CA \times WA) = \text{Total Staging Area}$$

Where: CA = Usable cargo area per ship in square feet or meters,

S/A = Safety/Accessibility Factor, normally 2,

SV = 2 = Factor to account for follow-on vessel, and

WA = .75 = Factor to account for working areas, multiple, vessels, rail and convoy reception areas, etc.

The last of the three subsystems is vessel-loading. The ideal terminal should provide adequate berthing for a number of panamax-sized vessels required to support the equipment loadout. Since DoD relies on the support of either RO/RO or RO/RO combination containerships; the existing port facilities should be able to handle these types of vessels. [Ref. 9:p.10] Compton also suggests that the ports provide at least 38 feet pierside and 40 foot channel depths to accommodate the vessels.

In conclusion, the article points out that the major difference between the ideal marine terminal and other types of terminals that have traditionally supported military operations is that the military historically has relied on break bulk terminals. In the future years, the military will need to load RO/RO cargoes and containers so rapidly that older terminals will not effectively support military efforts. Compton, envisions the future opportunities are obtainable through dual-purpose terminals, with multi-vessel capability.

3. Agile Port Concept

The Agile Port Concept (AP) Operational Concept was developed by the Center for the Commercial Deployment of Transportation Technologies (CCoDoTT), under contract and financial support from the Department of Defense. [Ref. 30:p.2] The AP concept envisions the use of state-of-the-art material cargo handling technologies, tagging, and tracking information management systems [Ref. 8:p.6-1] as a means to achieve one of its objectives - improving military throughput at ports. At the heart of the concept is the premise of integrating the physical port and terminal configuration design with material and information handling to permit cargo to pass through more rapidly than under current practices. [Ref. 30:p.3] The expected benefits with an AP will be: (1) increased throughput, (2) decreased port congestion, (3) increased port mobilization, and (4) increased asset visibility.

Briefly, the concept envisions using High Speed Sealift (HSS) ships in tandem with Agile Ports supported by C4I technologies to rapidly deploy forces. The initial notification process relies on state-of-the-art command and control networks (C2) to initiate the deployment process (e.g., unit movements and load planning). Data pertaining to movement of units will be captured by automated measurement and data collection systems such as the Transportation Automated Measurement System (TrAMS) [Ref. 30:p.5] shown in Figure 14.

Military units will travel to the ports over strategic corridors and enter through automated gates that capture and confirm the inventory of material directly to ship side. [Ref. 30:p.5] Just as in the case of the SL&D concept discussed in Chapter IV, AP requires units to arrive at the ports in a planned "just-in-time" sequence to commence loading nearly simultaneous with the arrival of the ship. The port environment is where the new technologies and innovations will be utilized to achieve the expected gains in throughput.

Ports will be equipped with video-imaging technology and electronic tag readers/interrogators; material arrival and condition can be captured and transmitted to the Global Transportation Network (GTN), the DOD transportation C2 system. [Ref. 30:p.8] On the material handling side of port operations, AP expects to use the latest available technology, including robotic MHE to facilitate the movement of equipment within the boundaries of the terminal yard. The Global Positioning System (GPS) will be extensively used to monitor the movement and location of containers/cargo/material.

The AP concept is offered in three types to consider for DoD use:

1. Existing and developing commercial terminals and intermodal systems which can be used "as is" by simply booking cargoes with the operators of the systems.

2. Existing strategic port terminals and land transportation systems (rail, highway) that, when supplemented by DoD systems and compatible commercial systems, for ad-hoc intermodal paths that extend at least from the strategic deployment installations (such as Ft. Hood and Ft. Stewart) to the ports of debarkation and perhaps even the foxhole.

3. Airlift Container Systems (ALICON) capable terminals, Inland Ports, and other intermodal concepts supporting HSS. [Ref. 8:p.6-10]

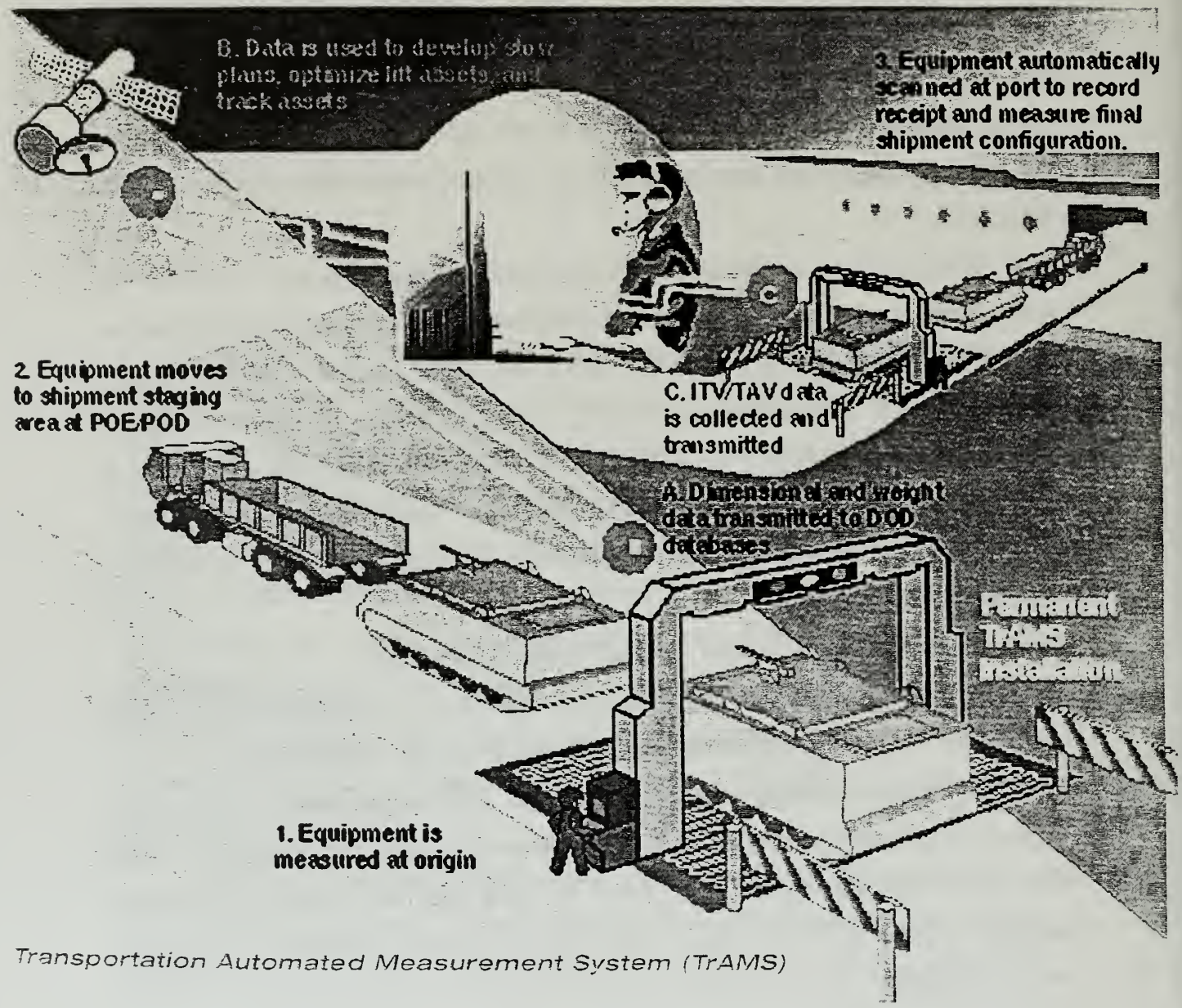


Figure 14. Transportation Automated Measurement System (TrAMS). [Ref. 8]

E. CONCLUSIONS

This chapter attempted to convey the relationships that exist between the U.S. ports and DoD in meeting the demands of rapidly deploying equipment, supplies, and cargo overseas in times of national emergency. This is a partnership that has proven capable of identifying and resolving conflicts through group conferences and preparedness exercises. In the future, as the port industry embraces for the projected growth in trade, military utilization priority at some ports will continue to be closely monitored and restricted in some cases. Therefore, DoD must continue to negotiate mutually beneficial agreements that are in the best interest of the military and the port community. Most importantly, our military requirements must consider the impact of disrupting commercial related activities.

The DoD can do its part by continuing to pursue new concepts and innovations available in the commercial sector to improve our interface with the ports. DoD must also be mindful that the port industry and accompanying intermodal entities are moving toward new technologies and automation to improve efficiency and productivity. These are competitive advantages that are readily available for DoD use. The Agile Port concept and the "Ideal Intermodal Marine Terminal" characteristics and their stated objectives are essentially no different than those concepts and techniques being explored in the commercial sector.

In the upcoming years, the willingness of ports to accommodate the demands and requirements of the military will fade. Ports have invested extensively in capital expansion projects and improvements to become more competitive and appealing to ocean carriers. In this new environment it will be incumbent upon military planners to not make overbearing demands on the port, but to engage in dialogue to understand each others position as it pertains to military mobilization efforts.

VI. ANALYSIS OF MILITARY MOBILIZATION OPERATIONS

A. INTRODUCTION

If DoD owned or maintained separate terminals and facilities to support contingencies such as Desert Shield/Storm, solicitation of the commercial port sector would not be required. However, since DoD does not maintain sufficient facilities to support DoD mobilization requirements, the commercial port sector is tasked with certain requirements and demands. The previous chapter shows that successful interface between DoD and the commercial port sector depends on: (1) a mutual understanding of the interested parties objectives and concerns, and (2) the port industry's ability to address their current array of issues.

The increase in port related-activities and competition at key strategic seaports presents a bad news, good news scenario for DoD. The bad news is that many ports are reluctant to make their facilities and terminals available for military use, and DoD will find it increasingly difficult to secure the most desirable port facilities for their mobilization needs. In fact, several ports have indicated a desire not to continue supporting DoD. And when the most desirable ports are available, military usage will likely be closely monitored and restricted to minimize the disruption of commercial activities.

On the other hand, because of the increased competition within the port industry, ports will strive to seek new practices and innovations in technology to improve productivity. This is the good news for DoD, who in its role as a customer of the port can leverage these new practices and technology to improve military throughput. If DoD hopes to take advantage of this situation it will mean keeping pace with the new trends that allow military port operations to be integrated into the port's operating infrastructure and the supporting intermodal network.

The intent of this thesis is not to take sides on the issues relating to military usage of commercial port facilities. Instead, the objective is to present a fair and unbiased analysis of the issues and circumstances affecting DoD usage. This chapter discusses the common objectives shared by DoD and the commercial sector, and provides an analysis of the current issues which may impact the interface between DoD and the commercial port sector. Lastly, alternative methods and practices aimed at improving military mobilization at U.S. ports are examined.

B. COMMON OBJECTIVES

Both the DoD and commercial port sector share common objectives that can serve as the starting point for joint collaborate projects and initiatives relating to military mobilization. For the moment if you think of the port as a company trying to satisfy a customer (such as DoD), each one of them would like to achieve the same outcome - the expeditious throughput of commodities. In the case of DoD, commodities would be equipment, vehicles, and supplies. Both entities are looking toward changing operating concepts and increasing their utilization of technology to provide gains necessary to improve efficiency. Specifically, the DoD and U.S. port community share common objectives in the areas of operational philosophies, and development of automation and technology.

1. Operational Philosophy

Both entities are moving in the direction of two concepts known in the intermodal environment as "seamless operation" and "just-in-time." The first concept infers that material being transported in the intermodal logistics network is moved from initial receipt by the port to final transfer aboard ship in a process that minimizes handling and disruption. Both envision future operations will follow the commercial "just-in-time" practice. In relation to the port, "just-in-time" requires equipment or containers to arrive at the port simultaneously with the vessel to begin immediate onloading. For DoD these

concepts involve moving equipment directly (when possible) from the installation to pierside staging areas then directly onboard waiting vessels.

These concepts are excellent opportunities for DoD to reduce container dwell time and help ease port congestion. Most assuredly, if DoD adopts these new practices, commercial disruption will be minimized. (These practices could also allow DoD to maximize its own throughput in a dedicated port.) The "just-in-time" strategy can prove to be even more beneficial to DoD if deployment planning includes bypassing marshaling yards and the use dedicated access corridors (rail or highway) in conjunction with off-terminal facilities. This practice will be elaborated on in later sectors.

2. Automation and Technology

In terms of automation and technology, an examination of various reference articles leads to a conclusion that both DoD and the commercial sector envision using similar techniques to achieve the desired outcomes. In the article, *Vessel and Port Technology at the Turn of the Century* [Ref. 49], the author provides a laundry list of suggested methods for improving terminal efficiency. There are striking similarities between this list and the ideas forwarded in the AP concept developed for USTRANCOM, as well as Ralph Compton's article [Ref. 9].

For instance, each article discusses the importance of maintaining total visibility of containers and equipment during the deployment process. The integration of EDI and AEI through computerization is recommended as the preferred method to facilitate tracking and monitoring of items. Improving gate and receipt processing was another common point. Automated processing gates using video ID cards and artificial intelligence and expert systems [Ref. 6:p.6] are to be used to manage yard stowage layout planning and work scheduling. The future trend will be to remove the human interface at the terminals gates and replace the process with management information systems that have the ability to automatically verify cargo and identify stowage locations.

The final commonality appears to be in the projected utilization of AGV systems (see Chapter IV) to enhance existing MHE or in moving containers around the yard in unmanned mini-trains. AGV systems have the potential not only to improve efficiency, but productivity as well. Presently, integrating AGV systems into existing port infrastructure for commercial or military use would be highly expensive. Introduction will also be met with opposition from the labor force (longshoremen and truckers) and their unions who will likely attempt to block any efforts to automate the handling of cargo within the terminal boundaries. AGV systems are trends of the future because they have the potential to reduce operating costs by eliminating expensive manpower and inefficiencies in material handling.

3. Analysis of Current Issues

The issues affecting DoD usage of commercial ports are realistic ones that will not be resolved in the short-run. As discussed in Chapters IV and V, the developing impacts and impediments to port effectiveness are complex issues that must take into consideration a multiple of stakeholder interests. From the DoD perspective, the issues that have the greatest potential to impact the military deployment process are linked to the U.S. ports own internal and external problems (some of which are beyond the control of the port).

Presently, the port industry is experiencing a period of intense competition and facility expansion. This is driven by the anticipated growth in international trade and expected rationing of port calls by ocean carriers in global shipping alliances. Against this backdrop, ports have been challenged to improve the level of service delivered to customers (commercial and DoD) or run the risk of losing business. Under this pressure many ports have determined that accommodating all customers is impractical and have chosen to reduce or in some cases sever relationships with DoD to better serve their commercial customers.

If you consider all three of the most pressing issues (port accessibility and availability, and military disruption of commercial activities) each of them could be resolved to some extent by improving productivity within the port infrastructure.

a. Port Accessibility

Port accessibility can be influenced by several factors. Examples include, the inability to quickly turnaround ships in a prescribed timeframe, and the presence of local city ordinances that restrict commercial traffic on public roads during peak commuter hours. DoD can do little from an operational perspective to ease this situation aside from using dedicated access corridors and off-terminal sites when possible to minimize traffic congestion at the ports. What DoD can do is use their political influence and work with other government transportation agencies to raise the level of awareness concerning landside and waterside access issues. In turn these agencies (like DOT) who are directly responsible for policy changes or allocation of roadway improvement can become more involved in addressing the issues.

b. Port Availability

In the future, ensuring port availability may dictate dispersing military deployments across different geographical regions or securing facilities in markets that are unappealing to commercial carriers. This will involve tradeoffs in costs and transit times. But, if availability is guaranteed, the tradeoff may be worthwhile and beneficial to military mobilization planning. There are some individuals that argue the issue of port availability is directly related to the capacity of the ports. However, the DOT considers the capacity of the nation's seaports to be adequate to meet the projected requirements for national defense, although it recognizes that a large increase in cargo movement would strain the system. [Ref. 41]

If anything, the industry is presently experiencing excess capacity. U.S. container ports are now operating at 50 percent to 70 percent of their estimated capacity.

[Ref. 37] Concrete examples of this situation are offered by the surplus of container facilities in the Northeast: in Boston, New York (Howland Hook, one of the largest container facilities in the U.S., has been vacant since the 1986 bankruptcy of U.S. Lines), and Baltimore (Segirt Terminal, built by the state of Maryland at a cost of over $250 million). [Ref. 37]

If DoD wants to continue to chose those ports that are most attractive in supporting military deployments, then every effort must be made to ensure that military deployment practices parallel the commercial customer interface with the ports. This may mean emphasizing the use of containers or making operational changes which minimize the disruption of commercial-related activities.

c. Disruption of Commercial Port Activity

It is not hard to understand why ports are reluctant to offer their facilities and terminals without restrictions to military usage. This thesis has described in detail the current port environment from an operational and financial position. I can conclude most U.S. ports are more than ready to support DoD efforts under any circumstances. However, the potential disruption to commercial activities which can result from military deployments poses to great a threat to the business of some ports.

Some personnel closely related to the port industry who did not want to be cited, indicated that DoD is partly to blame for their current posture. During Desert Shield/Storm ports were tasked with an incredible amount of responsibilities as described in Rexford B. Sherman's article, *Ports at War*. [Ref. 36] These duties did not necessarily strain the port limitations, but in combination with short notice adjustments to prearranged activities, relationships suffered. To reverse the attitudes of many ports, DoD must work to eliminate short notice changes through constructive preplanning conferences with the ports and pursue those deployment practices that are supportive and not disruptive to commercial activities.

C. ANALYSIS OF ALTERNATIVE PRACTICES AND METHODS

It should be evident that the practices and methods available to DoD must be supportive in addressing the current issues discussed previously. Of course, they should also enhance the productivity and throughput of military deployments. In fact, the concepts under development or being recommended for implementation by outside sources are supportive in meeting these objectives. DoD appears to be engaged in pursuing paths similar to the commercial sector as evidenced by its interest in utilizing dedicated corridors, off-terminal container facilities, enhanced receiving and processing techniques at terminal gates, and automated MHE. From the available literature, there is no argument that these are some of the best opportunities for improving military throughput.

Additionally, if the military wants to take advantage of the commercial opportunities available to improve efficiency then certain changes must be instituted. The commercial port sector is developing strategies and techniques to make better utilization of the intermodal network. Such strategies involve adopting the "just-in-time" concept of timing the arrival of loaded containers and equipment nearly simultaneously with that of the vessel. In most cases, the port industry is moving in a direction which will be supportive of their ultimate long range strategy of the direct transfer of commodities from the domestic intermodal mode to the ocean vessel. In this context, DoD should be following the same long-range strategy.

1. Just-in-Time Concept

This concept is one of the best alternatives for DoD. Not only does the concept reduce port congestion, it minimizes the disruption of commercial activities at the ports. Just-in-time requires a clearly planned sequence of events to facilitate the timing of equipment arrival with the ship. For the military, if this concept is instituted it will necessitate improvements in vehicle identification and tracking, strict adherence to

deployment schedules, and most importantly, effective predeployment planning and coordination.

2. Agile Port Concept

The Agile Port (AP) concept can be viewed as DoD's response to integrating the military deployment process into the existing port infrastructure. Based on reference material, [Ref. 30 and 8] if the AP concept can accomplish all of its deliverables it will greatly improve military efficiency at U.S. ports. The concept pulls together the best characteristics of the three subsystems of military deployments: reception and terminal handling, staging, and vessel loading. [Ref. 9:p.9] Additionally, the AP embodies several other important concepts including High Speed Sealift (HSS) and the Inland Port which can assist in further improving efficiencies.

As stated in Chapter V, this concept hopes to integrate the physical port and terminal configuration design with material and information handling to permit more cargo to pass more rapidly than with current practices. What is equally important is that AP will utilize the latest cutting edge technologies and processes available in the commercial port sector (e.g., robotic MHE and AGV) with the intent of improving military throughput at U.S. ports. However, I believe full implementation will require some changes to existing operating practices, in particular by bypassing marshaling yards (when possible) as discussed in a later subsection. Port communities will also have be supportive of this concept because the AP port integration issues. Although, the references did not mention the costs associated with developing this concept, any system of this level which includes so many interdependent subsystems will be expensive to fully implement. Where will the funds come from to upgrade existing facilities and terminals to support the AP concept?

3. User-Friendly Terminal

Ralph Compton's [Ref. 9] depiction of the ideal marine terminal includes characteristics similar to those of the AP concept and other references which put forth suggestions on improving military throughput at ports. His terminal foresees the use of near-real-time cargo visibility and dedicated corridors for easy accessibility to the port, and calls for detailed deployment planning to provide greater flexibility in mobilization. All these ideas support enhancing port efficiency.

I agree with Compton in two important aspects. He recommends that military planners work with the intermodal industry to help identify possible solutions to the military deployment problems. The intermodal industry presents a wealth of knowledge, and as the industry goes about making improvements in its methodologies and systems, DoD should take full advantage of the opportunities as a partner in the process. [Ref. 9:p.10]

In his final analysis, Compton also suggests the answer lies with dual-purpose terminals. I would agree that terminals identified for military use should be capable of handling RO/RO and RO/RO combination containerships. DoD places a heavy emphasis on the use of these vessels during the surge phase of unit deployments, and their special handling requirements are typically different than commercial vessels as stated in Chapter V.

However, the use of dual-purpose terminals to some extent is not supportive of DoD leveraging the advantages of the commercial port sector and intermodal industry. It would seem that the key essential process to improving efficiency lies in integration, not separation. The more DoD can integrate their functions into existing networks and systems, the less likely military deployments will disrupt commercial activities or contribute to port congestion. Dual-purpose terminals would be useful if the necessary funds were available to support and maintain them. But if the recent downsizing of

Military Ocean Terminals (MTOs) is any indication of DoD long range planning, operating separate facilities is not in the strategic outlook.

4. Off-terminal Facilities

DoD receives the greatest benefits by having capabilities to transport deploying units directly from their installations to waiting ships. However, DoD still utilizes marshaling yards as part of the deployment. This is an additionally step which is in direct conflict with the principles of intermodalism and "just-in-time" operation. Understandably some equipment and vehicles cannot arrive at the port containerized and therefore require some reconfiguration and preparation before being stowed aboard ships. But, marshaling yards contribute to port congestion and tie up valuable commercial yard space. When possible, the stowage preparation functions should be to shifted to off-terminal sites such as an inland port or intermodal container transfer facility. Then equipment and vehicles when ready can be transported via rail or other alternative methods (AGV systems) directly to port for immediate processing and loading aboard a waiting vessel. This practice is another opportunity for DoD to minimize their impact on port congestion and yard space while improving throughput efficiency.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The port industry, like many industries, is subject to increasing competition. For ports, this is derived from the projected introduction of next-generation containerships, emerging global shipping alliances, and increasing international trade. Keeping pace with the rapidly changing environment requires modernizing existing facilities and terminals. Ports are experiencing the direct effects of this restructuring. Established ports with the capital to finance costly improvement projects will eventually become the preferred ports of call for carriers. The smaller ports will be squeezed out by the rationing of port calls, having neither the market base nor the financial wherewithal of their larger competitors. [Ref. 10:p.299] In the long run the industry will be more streamlined with the larger ports serving as regional load centers supported by smaller feeder ports.

Based on the research conducted, this section summarizes the findings currently facing the port industry.

1. Need for National Awareness of U.S. Port Issues

There is no dispute that the equation for success in the port industry will depend on the industry's ability to address the pressing environmental and port congestion problems. In this era of competition, certain traditional advantages will become even more significant – deeper channels, speedy access to major shipping lanes, large affluent populations that generate large volumes of imports, and industry bases that generate both exports and imports. [Ref. 6:p.5] Because some of the issues currently facing the port industry involve national policy, it is apparent the port community requires a national agency to represent their interests and concerns. MARAD is responsible for the

promotion of ports, but there is no one agency identified to act on behalf of the ports in addressing the broad range of problems (e.g., dredging or construction of national corridors) currently plaguing the industry discussed in Chapter IV.

Furthermore, in 1994 U.S. port activity was responsible for generating over 1.6 million jobs. [Ref. 46:p.3] This equates to the creation of one job nationally for every 1,858 metric tons of waterborne commerce moved. The economic activities of the port are of vital importance to the U.S. economy as well as the local economies of stakeholders who oppose expansion efforts. As indicated in Chapter III, capital expenditures related to port business activities is on average about $1 billion per year. Because of port industry's economic contributions, it will be important to ensure they remain competitive despite the changing environment. Their continued success depends on whether or not the impediments to (organizational) effectiveness discussed in Chapter IV can be addressed. In my opinion, one of the best alternatives to facilitate this process is through the establishment of a national agency or committee to openly discuss the issues.

2. Influential and Uninformed Stakeholder Base

Port development plans and transportation needs in urbanized areas often conflict with the interests of neighborhood groups opposed to traffic noise and congestion. [Ref. 41:p.17] Stakeholders concerned with protecting the neighborhood, environmental, and historic qualities of their communities have become much more involved in local planning. Because of the power and influence the stakeholders and local governments have over zoning and land use planning decisions, local zoning board hearings are typically the point at which transportation concerns are weighed against preservation goals. [Ref. 41:17]

If you polled stakeholders on questions relating to a port's contributions, I believe most would be unaware of the economic importance. In most cases, local residents are

uninformed as to the positive benefits the ports bring to their communities. Port officials can improve the public image, advancing their cause by working closely with neighborhood groups, environmentalists and local planning officials while they are planning improvements. This will enable them to develop and negotiate projects more acceptable to all parties, and help avoid litigation by groups opposed to such projects. [Ref. 41:p.10]

3. Opportunities for Improving Port Efficiency and Productivity

Ports have put a full faith effort into improving their own condition by improving terminal efficiency and investing millions into new facilities and innovations in technology. The use of automation in material handling equipment and gate processing supported by sophisticated computerization are being considered to improve productivity and efficiency. Additionally, ports are exploring and using the technology available in management information systems to better manage gate processing and yard utilization. Lastly, the port industry is preparing itself to take full advantage of the opportunities of intermodalism to improve efficiency and reduce costs. The latter improvement will be exhibited by a greater emphasis on container traffic, use of dedicated corridors, and off-terminal facilities to reduce the congestion at ports. Propelling the continued development of intermodalism are global realities which will demand "just-in-time" delivery of goods and merchandise.

4. Changing Port Environment Implications for DoD

For DoD, as discussed in the preceding chapter, the changing port environment is both a good news and bad news scenario. The good news is that the industry will be more responsive to DoD customer requirements because of the increased competition between ports which demands that efficiency and productivity be improved. In the upcoming years, the commercial transportation sector will continue to invest in new

equipment and technology to enhance its systems to become more competitive and reduce overall costs. These transportation advantages can be put to use in the defense sector. The benefits that the military can derive from containerization and intermodal transportation are the same as in the commercial sector: lower costs, decreased transit times, and lower rates of damage. [Ref.14:p.68] The common link is the use of the same port terminals and intermodal access routes to the port.

The bad news is that in this climate of intense competition, ports are unwilling to offer their facilities freely to military deployments. Although, DoD interface with U.S. ports during Desert Shield/Storm was viewed favorably by all interested parties and outside observers. The port community is now more reluctant to participate in any activities that will result in a potential disruption of commercial activity. Rapid deployment is now an important component of national strategy which requires immediate accessibility and availability to strategically located seaports. When those facilities are unavailable or restrictions apply, the entire deployment process must be adjusted resulting in lost transit days.

To their credit (DoD) has identified these problems and begun to explore alternative methods to reduce military disruption at port facilities and terminals. The AP concept is an example of a proposed concept that will use different innovations and technology to improve military throughput at U.S. ports. If DoD desires to return to a position of selectively choosing the optimal port facilities and terminals for military deployments. Then our deployment planning must be inclusive of concepts, technology, and practices that can be easily integrated into the existing port infrastructure. It is quite obvious that the commercial sector is to some extent moving toward the direct transfer of cargo from the mode of transport to the ship. Therefore, DoD planning should be in line with the developing trends within the commercial transportation sector.

B. RECOMMENDATIONS

Recommendations in this section can not solely represent the view of any one perspective or be entirely of a technical nature. Chapter IV provided a stakeholder map for the U.S. port industry (see Figure 7) to convey how many different interests must be considered and preserved before the port can make any decisions. Without question, the most available means to address the challenges and issues for U.S. ports and DoD is through the pursuit of new technology and automation to improve efficiency. However, as pointed out in this thesis, changes in traditional operating practices are also necessary to obtain the desired outcomes.

Based on the issues explored previously, this section offers recommendations for improving: (1) the relationship between stakeholders and the port, (2) military and commercial throughput, and (3) changes in operating practices.

1. Establishment of a National Agency or Committee.

To act on behalf of port authorities in bringing national attention to current issues facing U.S. ports, no single agency has complete authority to bring the different perspectives together to address issues. Modernizing U.S. ports will require a coordinated effort on many fronts. The first step is to ensure that all parties recognize the scope of the problems. This can be accomplished by instituting a national dialogue on the future of the nation's ports. [Ref. 4:p.75] The Department of Transportation has accomplished this to some extent on a regional level by sponsoring conferences on the "Impacts of Changes in Ship Design on Transportation Infrastructure and Operations." The DoD should be an active participant in this dialogue.

2. Federal Government Involvement

The Transportation Research Board article, *Landside Access to U.S. Ports,* recommends that the Office of Intermodalism ensure that federal research is conducted on

topics related to efficient flow to and through port complexes. This is a necessary step if U.S. ports want to remain competitive in the international trade market. The federal government should serve as a catalyst to bring together the various parties involved in the use of technologies, such as information systems, in order to define joint needs to promote standardization. In addition, government agencies should encourage research on and dissemination of innovations in cargo handling and intermodal freight transportation. [Ref. 41:p.15] These efforts will also facilitate the throughput of DoD surge and sustainment material in a contingency context.

3. Regional Planning for Port Needs

With the projected volume of tonnage expected to double in the next decade it will become increasingly important to plan early for the expected port expansion and increased traffic. Making the necessary improvements in rail and road access routes to address the landside access problems will require regional planning that takes ports needs into account. Because the intermodal network crosses different geographical boundaries, regional planning will be necessary to ensure the smooth flow of commodities. For example, it would make no sense for California to develop the Alameda Corridor and the surrounding highway structure to support intermodalism when neighboring states intermodal networks are not maintained. The DoD will also benefit from these efforts.

4. Educating Stakeholder

Port officials should be actively educating all elected officials, and commercial, neighborhood and environmental groups about the transportation needs of the ports, and the role ports play in moving international commerce and providing for national defense, and the economic benefits ports give to their cities and regions. [Ref. 41:p.17] Additionally, educating stakeholders gives them the feeling they are part of the planning process. Therefore, when issues arise that pertain to their area of interest they will less

likely to adopt a defensive posture which can result in project delays or extensive back and forth dialogue.

5. Use of Automation and Technology

The use of automated processes and innovations in technology in military deployment planning is essential. First, it allows DoD to take advantage of the commercial transportation sector initiatives in these areas; which means the military does not have to invest in the costly development stages of systems. Second, automation and technology provides an opportunity for DoD to improve military throughput and efficiency at U.S. ports. The latest technological advances available for use include management information system to enhance in-transit asset visibility, automated cargo handling systems and AGV systems. Many of these concepts are identified in Ralph Compton's, ideal intermodal marine terminal concept [Ref. 9] and the Agile Port concept discussed earlier.

6. Reduction of Port Congestion

One opportunity for easing port congestion problems is operating the port for more hours each day. This would involve expanding the traditional workday to work around the peak commuter hours. Terminal operators, users and labor representatives should collaborate to find new ways to increase the hours of terminal operations at an affordable cost, coordinate schedules to minimize traffic conflicts, and alter ship-loading schedules to minimize last minute peak demands on terminal facilities. [Ref. 41:p.18] Additionally, the port should push initiatives to eliminate unnecessary paperwork associated with processing procedures and apply management information systems to improve efficiency. This will increase the throughput capacity of individual ports, and among other things, reduce the impact of military activities on commercial port operations.

7. Changes in Deployment Planning

The direct transfer of cargo and "just-in-time" practices are future trends of the commercial transportation sector. DoD must ensure their strategic plans incorporate these concepts. Future plans should also reevaluate the use of marshaling yards. As previously mentioned, marshaling yards contribute to a number of issues DoD is trying to minimize. The use of off-terminal sites or inland port facilities (when possible) in conjunction with dedicated corridors would allow military units unimpeded access to U.S. ports. In turn, port congestion is minimized and the deployment process is less disruptive to commercial port traffic.

Appendix. Projected Containership Orders

Company	Quantity and Capacity
P&O Containers	2 x 6,674 TEU
Maersk Line	12 x 6,000 TEU
NYK	5 x 5,700 TEU
COSCO	6 x 5,250 TEU
Hyundai	8 x 5,040 TEU
Hanjin	4 x 5,000 TEU
Evergreen	5 x 5,364 TEU
OOCL	8 x 5,364 TEU
Neptune Orient Lines	6 x 4,900 TEU

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